ERDA RESEARCH ABSTRACTS

Volume 1 Number 1
Abstracts 1-999

January 1976

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ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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Published by the USERDA Technical Information Center

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Personal Authors

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SCHRAM, A., See BESNARD, A., 75:830
SCHULER, R.H., Calculator-plotter routines for numerical integration of kinetic expressions, 75:855
SCHULER, V.J., Experimental studies in guiding marine fishes of Southern California with screens and louvers, 75:984
SCOTT, C.D., See JOLLEY, R.L., 75:847
SCOTTI, L.J., See HAMSHAR, J.A., 75:705

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

COAL/PURIFICATION
Application for the benefaction of coal utilizing high volatile liquids as chemical comminutants (Use of liquid anhydrous NH_3 at -33°C to reduce size of coal particles), 75:702
COAL GASIFICATION
See also COED PROCESS
SYNTHANE PROCESS
COAL GASIFICATION/BI-GAS PROCESS
Environmental aspects of the BI-GAS process (Reactive components in coal are completely used in process, and ash for disposal is in form of granular, vitreous slag), 75:715 (EPA-650/2-74-118)

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00821 (TE--4190-57-75) ADVANCED THERMIONIC TECHNOLOGY, FY1975. PROGRESS REPORT NUMBER 4, OCTOBER 1974. **(Thermo Electron Corp., Waltham, Mass. (USA)).** 1975. Contract AT(11-1)-3056. 18p. Dep. NTIS $4.00.

is indexed as:

TEXAS INSTRUMENTS, INC., DALLAS (USA)
Development of low-cost thin-film polycrystalline silicon solar cells for terrestrial applications. Third quarter progress report, July 1, 1974--September 30, 1974, 75:00744 (NSF-RA/N--74-144)
TEXTRON, INC., SYLMAR, CALIF. (USA). SPECTROLAB DIV.
Terrestrial photovoltaic power systems with sunlight concentration. Quarterly porgress report, July 1, 1974--September 30, 1974, 75:00737 (NSF-RA/N--74-129)
THERMO ELECTRON CORP., WALTHAM, MASS. (USA)
Advanced thermionic technology, FY1975. Progress report number 4, October 1974, 75:00821 (TE--4190-57-75)
TYCO LABS., INC., WALTHAM, MASS. (USA)
Continuous silicon solar cells. Third quarter progress report, July 1, 1974--September 30, 1974, 75:00742 (NSF-RA/N--74-139)
Scale-up of program on continuous silicon solar cells. Semiannual progress report, May 1, 1974--June 30, 1974, 75:00735 (NSF-RA/N--74-089)

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The Administrator of the Energy Research and Development Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.

Volume 1, Number 1, January 1976

ERDA RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

PROCESSING

GASIFICATION

00001 (MERC/SP—75/1) **Instrumentation for in situ coal gasification.** Shuck, L.Z.; Fasching, G.E. (Energy Research and Development Administration, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Aug 1975. 22p. Dep. NTIS $4.00.

Concepts and techniques for delineating characteristics of the remote in-situ coal gasification processes are presented. The concepts are discussed in relation to an in-situ or underground coal gasification (UCG) program which was initiated in 1972 with primary objectives of measuring more quantitatively the intensive and extensive properties. Emphasis was placed upon measurements for the purposes of research diagnosis and analysis, commercial monitoring, micro and global process simulation, and process control and optimization. The remote nature of the process renders the measurement task technically and economically difficult. Instrumentation techniques are categorized according to surface or subsurface locations and laboratory and field applications. The role of laboratory experiments in developing process simulation programs, and instrumentation systems for measuring, monitoring and controlling the process is reviewed. (auth)

00002 (SAND—74-0394) **Temperature instrumentation for the Hanna Research Site Well 16 of the Laramie Energy Research Center in situ coal gasification project.** Reed, R.P.; Morris, R.W.; Birdsong, O.J. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jul 1975. Contract AT(29-1)-789. 33p. Dep. NTIS $4.75.

The Laramie Energy Research Center (LERC) of the U. S. Bureau of Mines conducted a brief coal gasification experiment at Well 15 of the Hanna Research Site in April 1974. Sandia Laboratories emplaced special thermocouple instrumentation in adjacent instrument Well 16 to measure the space and time profile of temperature in the coal zone and its overburden. An anomalous temperature elevation in the overlying shale in the period preceding the burn experiment revealed the presence of an extensive fissure connected to previously burned remote sites. The fissure could have adversely affected the burn experiment by channeling the gases past, rather than through, the coal seam. Although ignition of the coal was prevented by an obstruction at the bottom of Well 15, the usefulness of multipoint temperature sensors as diagnostic tools for in situ studies was demonstrated in practice. This report describes the special branched multipoint thermocouple circuitry used in that study. Results of the measurement experiment are described. (auth)

00003 **Agglomerating combustor-gasifier method and apparatus for coal gasification.** Chen, J.L.P.; Archer, D.H. (to U.S. Energy Research and Development Administration). US Patent Application541,376. Filed date 15 Jan 1975. 14p.

A method and apparatus for gasifying coal wherein the gasification takes place is a spout fluid bed at a pressure of about 10 to 30 atmospheres and a temperature of about 1800 to 2200°F. The configuration of the apparatus and the manner of introduction of gases for combustion and fluidization is such that agglomerated ash can be withdrawn from the bottom of the apparatus and gas containing very low dust loading is produced. The gasification reaction is self-sustaining through the burning of a stoichiometric amount of coal with air in the lower part of the apparatus to form the spout within the fluid bed. The method and apparatus are particularly suitable for gasifying coarse coal particles. (auth)

00004 **Coal conversion technology.** Zahradnik, R.L. (Office of Coal Research, Washington, DC). *Trans. Am. Nucl. Soc.;* **21**: 143(Jun 1973).

From Transactions of the American Nuclear Society 1975 annual meeting; New Orleans, LA (8 Jun 1975).

PROPERTIES

00005 (BNWL-SA—5457) **Inferences on the structure of coal: ^{13}C nmr and ir spectroscopy.** Franz, J.A.; Morrey, J.R.; Cambell, J.A.; Tingey, G.L.; Pugmire, R.J.; Grant, D.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 8p. (CONF-750806—2). Dep. NTIS $4.00.

From 170. American Chemical Society national meeting; Chicago, Illinois, USA (24 Aug 1975).

A modified method of Ouchi and Heredy for depolymerizing coal shows great promise for obtaining substantial fractions in true solutions. These solutions can be used in high-resolution ^{13}C nmr studies and in infrared studies to elucidate the basic structures of coals. The technique has been demonstrated for a high-volatile bituminous C coal. This research is being pursued in an attempt to obtain structural information, particularly with emphasis on the functional groups in coal and their effect on its reactivity. (auth)

PETROLEUM

DRILLING AND PRODUCTION

00006 (BM-RI—7899) **Error in gas drive calculations caused by ignoring compressibility and solution effects.** Carlson, F.M.; Land, C.S. (Energy Research and Development Administration, Laramie, Wyo. (USA). Laramie Energy Research Center). 1974. 21p. Dep. NTIS $4.25.

Comparisons were made between the results of the Buckley-Leverett and Kern solutions, which describe immiscible displacement of oil by gas in a linear system and the results obtained from a less restrictive numerical model. This model takes into account the effect of compressibility of the oil and gas and the effect of allowing changes in the amount of gas in solution in the oil. These effects are best exemplified by imposing large pressure drops across the system. With these large pressure drops, comparison of the model solution with the Buckley-Leverett solution reveals that the Buckley-Leverett solution provides estimates of recoveries at breakthrough of the gas that are too low. In contrast to the model, the Kern solution predicts breakthrough recoveries that are too high. A modification to the Kern solution is presented to facilitate more accurate predictions of recovery at gas breakthrough for gas injection at pressures higher than the saturation pressure of the oil. (auth)

PROCESSING

00007 **Analysis of acids in high-boiling petroleum distillates.** McKay, J.F.; Cogswell, T.E.; Weber, J.H.; Latham, D.R. (Laramie Energy Research Center, WY). *Fuel;* **54**: No. 1, 50-61(Jan 1975).

The major acidic compound types in ten high-boiling crude-oil distillates were identified as carboxylic acids, phenols, car-

bazoles, and amides. Acids from crude oils having different geological characteristics were separated using a standardized separation scheme involving the use of gel permeation, adsorption, and thin-layer chromatography, and preliminary comparisons have been made between the compositional results. In one method, compound types were isolated and the percentage of each was determined gravimetrically; in two other methods infrared spectrometry was used to estimate the relative amounts of individual types. The structures of the acidic compounds were examined in detail using mass fluorescence and nuclear-magnetic-resonance spectrometry. Trace amounts of pericondensed polyaromatic hydrocarbons were found in all the acid samples. (auth)

HEALTH AND SAFETY

00008 (ORNL-tr—2977) **Loading of atmospheric air with carcinogenic polycyclic aromatic hydrocarbons from petroleum processing installations.** Kireeva, I.S.; Yanysheva, N.Ya. Translated by M. Gerrard from *Gig. Naseiennykh Mest;* No. 9, 113-117(1970). 4p. Dep. NTIS $4.00.

Air sampling was carried out at a petroleum processing plant. The plant processes around 3 million tons of petroleum per year and includes atmosphere-vacuum equipment for thermal cracking, asphalt and coking equipment, and a number of preparatory and accessory shops. Carcinogenic hydrocarbons were determined in the samples by multistage fractionation using column, paper, and thin-layer chromatography. (MCG)

OIL SHALES AND TAR SANDS

SITE GEOLOGY AND HYDROLOGY

SITE GEOLOGY

00009 **Computer simulation of charged particles in solution. II. Polyion diffusion coefficient.** Ermak, D.L. (Univ. of California, Livermore). *J. Chem. Phys.;* 62: No. 10, 4197-4203(15 May 1975).

A computer simulation study was conducted on the effects of the polyion--small ion electrostatic interaction upon the translational diffusion of polyions in polyelectrolyte solutions at thermodynamic equilibrium. This interaction increased the polyion diffusion coefficient and the increase was strongly dependent upon the polyion charge and size, and the small ion charge and mobility, while only slightly affected by changes in the polyion concentration. The increase was largest when there were only enough counterions to balance the charge of the polyions. Increasing the number of counterion--byion pairs per polyion decreased the polyion diffusion coefficient toward its uncharged value. The computer results were markedly different from those predicted by the self-consistent field theory of Stephen and a comparison of the two is presented. (auth)

OIL PRODUCTION, RECOVERY, AND REFINING

00010 **Oil-shale pyrolysis: kinetics and mechanism of oil production.** Braun, R.L.; Rothman, A.J. (Univ. of California, Livermore). *Fuel;* 54: 129-131(Apr 1975).

Literature data on the thermal decomposition of the organic material in Colorado oil shale are analyzed. Inclusion of a thermal induction period in the data analysis results in a concise interpretation of the kinetics of oil production in terms of a simple mechanism involving two consecutive first-order reactions. The rate constants and activation energies for these two reactions are deduced. (auth)

SURFACE METHODS

00011 **Treatment of middlings stream from hot water process for recovering bitumen from tar sand.** Cymbalisty, L.M.O. (to Canada-Cities Service, Ltd.; Atlantic Richfield Canada, Ltd.; Imperial Oil Ltd.). US Patent 3,864,251. 4 Feb 1975. Filed date 22 Jan 1974. 4p.

This process relates to treating the middlings stream from the primary separation cell used in the hot water process for extracting bitumen from tar sand. The middlings stream is diluted with hot water and settled in a quiescent zone. Froth is formed in the settler; this froth is surprisingly low in solids and water. The tailings stream from the settler is recycled to the front end of the extraction process, thereby conserving water. The invention provides an alternative to the conventional sub-aeration cell used for treatment of the middlings stream. (auth)

PROPERTIES AND COMPOSITION

00012 (BM-RI—8018) **Thermal reactions of shale-oil components: plant pigments as probable precursors of nitrogenous compounds in shale oil.** Jackson, L.P.; Decora, A.W. (Energy Research and Development Administration, Laramie, Wyo. (USA). Laramie Energy Research Center). 1975. 24p. Dep. NTIS $4.25.

Reduced chlorophyllins were prepared and pyrolyzed in an effort to identify the role of plant pigments and their decomposition products in the nitrogenous compounds found in the product of oil-shale pyrolysis. The properties of the chlorophyllin pyrolysates were related to the composition of the reduced chlorophyllins with particular emphasis on the amount and types of nitrogen compounds formed. A comparison based on the types of nitrogen compounds present was made between shale oil and the chlorophyllin pyrolysates. In order to make this comparison, a sample of shale-oil light distillate was separated into polar and nonpolar fractions, and a careful examination of the polar fraction was conducted to obtain an accurate picture of the types of nitrogen compounds present. The information gathered from these studies was used to evaluate reduced chlorophyllin as a model of oil-shale kerogen insofar as the production of nitrogen compounds was concerned. The results indicate that the reduced chlorophyllin does yield nitrogen products which are directly related to the nitrogenous compounds in shale oil, and it therefore represents a good model of shale-oil kerogen. (auth)

WASTE RESEARCH AND MANAGEMENT

00013 **Tailings disposal system for tar sands plant.** Schutte, R. (to Canada-Cities Service Ltd.; Imperial Oil Ltd.; Atlantic Richfield Canada Ltd.; Gulf Oil Canada Ltd.). US Patent 3,869,384. 4 Mar 1975. Filed date 21 Jan 1974. 4p.

A process is described for the treatment of the tailings stream from a hot water extraction plant for recovering bitumen from tar sand. This stream comprises water and coarse and fine solids. The stream is fed into a mined-out cavity to settle the coarse solids. Some of the decanted water from the cavity is transferred to a large settling pond for clarification. The remainder of the decanted water is returned to the plant and added to the tailings stream to fluidize it and render it pumpable. Some of the fines become trapped in the beach of coarse sand formed in the cavity, thereby reducing the volume of sludge which is generated in the settling pond. The use of decanted water to fluidize the tailings issuing from the extraction process reduces the amount of water needed for the extraction process itself, thereby reducing the amount of clarified water required for the plant. (auth)

FISSION FUELS

RESERVES

00014 (LA-UR—75-1127) **U.S. studies of the Oklo phenomenon.** Cowan, G.A.; Bryant, E.A.; Daniels, W.R.; Maeck, W.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 22p. (CONF-750641—2). Dep. NTIS $4.25.

From IAEA International symposium on the OKLO phenomenon; Libreville, Gabon (23 Jun 1975).

Analyses of samples from the Oklo site are in agreement with previous reports by Naudet et al concerning the occurrence of a natural chain reaction in Precambrian times. A preliminary modeling of the reactor suggests that the event took place 1.7 to 1.9 b.y. ago, and that the period of criticality lasted at least 2×10^5 years. Uranium may have accreted and, to a lesser extent, migrated during the period of criticality or subsequent to it. (auth)

EXPLORATION

00015 (UCID—16883) **LLL uranium hydrogeochemical survey. Project highlights for July 1975.** Holder, B.E. (comp.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Aug 1975. Contract W-7405-Eng-48. 7p. Dep. NTIS $4.00.

Status of the LLL hydrogeochemical survey of Winnemucca Lake, Smoke Creek Desert, Cave Valley, and Roach Lake basins in Nevada is reported. A reconnaissance sampling of Winnemucca Lake was made to determine its accessibility by four-wheel drive vehicles and to test hand augering as a means of collecting samples. About 100 sediment samples were taken from alluvial fans and dry stream channels of Walker Basin. Preliminary survey analyses were performed on 24 samples from Walker River and its tributaries. (LK)

ENRICHMENT

00016 (UCRL—76923) **Separation of uranium isotopes by selective photoionization.** Snavely, B.B.; Solarz, R.W.; Tuccio, S.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 May 1975. 9p. (CONF-750653—1). Dep. NTIS $4.00.

From 2. laser spectroscopy conference; Megeve, France (23 Jun 1975).

Recent results of experiments on the laser photoseparation of U isotopes are reported. In the first series of experiments a two-step ionization process using a Xe laser to excite the atoms below the ionization level and then a Kr laser to ionize the atoms was described. Under the geometric conditions of the experiment and power of the Kr laser, enrichments between 2.5 and 3 percent were obtained in runs lasting 2 hrs. Calculations to describe the ion trajectories in the collector system reflected the two-band pattern observed on the Be collector plate. A system to study the photoionization process was assembled in which the U beam is excited to a desired energy level with a CW dye laser and an ultraviolet beam intercepts the excited U beam. An analysis of a photoionization spectrum obtained at a resolution of 8 A indicates that the peak cross section for transitions to autoionization states from the $^7M_7$ level is large enough to be used in large-scale U separation systems. An ionization value of 6.15 +- 0.2 eV was deduced for the ionization potential of the U atom. (JSR)

GASEOUS DIFFUSION

00017 (ERDA—1543(DR)) **Environmental statement: expansion of U.S. uranium enrichment capacity.** (Energy Research and Development Administration, Washington, D.C. (USA)). Jun 1975. 449p. W.H. Pennington, Office of Asst. Admin., Wash., DC. Free.

The current production capacity for enriching uranium for commercial nuclear power plants is fully committed to existing and currently planned domestic and foreign reactors. The postulated expansion required to support nuclear power growth through year 2000 is eleven enrichment plants, each of which is equivalent in capacity to an existing U. S. uranium enrichment plant. This Statement assesses the reasonably foreseeable environmental, social, economic, and technological costs and benefits of this expansion along with the reasonably available alternatives to such expansion. The environmental impacts of construction and operation of the postulated eleven additional plants would involve the commitment of approximately 8,000 acres of land for plant sites and power transmission lines. The major impact associated with the expansion will be due to the production of power required to operate the enrichment plants. This impact will be minimal since it is anticipated that the majority of the new plants will use the gas centrifuge process which requires only about ten percent as much electricity as the currently used gaseous diffusion process. The radiation dose to population living within 50 miles of the plants is estimated to be 0.05 percent of the dose received from natural radiation background. Alternatives considered included no expansion of enrichment capacity; limiting enrichment services to U. S. requirements; alternate ratios of diffusion and centrifuge plants; and alternate tails assays. (LK)

00018 (UCCND-CSD-INF—38) **Species separation in a curved shock wave in supersonic flow of a gas mixture.** Harris, W.L.; Tunstall, J.N.; Burris, J.H. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 13p. (CONF-750722—1). Dep. NTIS $4.00.

From 10. international shock tube symposium; Kyoto, Japan (14 Jul 1975).

This paper describes an extension and a synthesis of existing theoretical models of non-planar shock waves in gas mixtures. A means of predicting the modified Rankine-Hugoniot conditions and the species separation in gas mixtures in supersonic flow through curved, two-dimensional shock waves is presented. The results reported here are consistent with the structure of the shock being governed by the Navier-Stokes equations. The prediction algorithm is not limited by the mole fraction of the species in the gas mixture. The species are assumed to be non-reacting. The effects of mixture initial Mach number, initial mole fraction, free stream Reynolds number, component mass ratio, and shock standoff distance are described. Numerical results indicate that the species separation: (1) decreases with increasing polar angle; (2) increases with increasing mixture initial Mach number; (3) decreases with increasing shock standoff distance; and (4) decreases with increasing free stream Reynolds number. Consistent modified Rankine-Hugoniot conditions are also obtained. The analysis requires that the ratio of shock thickness to shock radius be of the order unity or less. An upper limit with regard to mixture initial Mach number and species mass ratio, beyond which the analysis is invalid, is described. (auth)

CENTRIFUGATION

00019 (UCRL-Trans—10891) **Evaluation of enrichment by centrifugal separation: the future of the centrifugal-separation method.** Kanagawa, A. Translated from *Genshiryoku Kogyo;* **20**: No. 2, 40-45(1974). 30p. Dep. NTIS $4.50.

A gas centrifuge plant for uranium enrichment is considered from the point of view of economic competition with other methods. Characteristics of the method are presented including: energy efficiency, the cascade, the separation coefficient, the equilibrium separation process, and capability as centrifugal pump. The structure of an individual gas centrifuge separator is described including the rotating cylinder, mechanisms for gas injection and extraction, mechanisms for counter-streaming of gas, the axle holder mechanism, the gas sealing mechanism, and the driving mechanism. (MCG)

00020 **Use of critical pathway models and log-normal frequency distributions for siting nuclear facilities.** Waite, D.A.; Denham, D.H. (Battelle Pacific Northwest Labs., Richland, WA). pp 407-415 of **Siting of nuclear facilities.** Vienna; International Atomic Energy Agency (1975).

From Symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974).

See STI/PUB—384; CONF-741210—.

The advantages and disadvantages of potential sites for nuclear facilities are evaluated through the use of environmental pathway and log-normal distribution analysis. An exposure pathway diagram must be developed. This type of diagram helps to locate pertinent environmental media, points of expected long-term contaminant accumulation, and points of population/contaminants interface for both radioactive and non-radioactive contaminants. Confirmation of facility siting conclusions drawn from pathway considerations must usually be derived from an investigatory environmental surveillance program. How these basic principles apply to the actual siting of a nuclear facility is demonstrated for a centrifuge-type uranium enrichment facility as an example. A model facility is examined to the extent of available data in terms of potential contaminants and facility general environmental needs. A critical exposure pathway diagram is developed to the point of prescribing the characteristics of an optimum site for such a facility. Possible necessary deviations from climatic constraints are reviewed and reconciled with conclusions drawn from the exposure pathway analysis. Details of log-normal distribution analysis techniques are presented, with examples of environmental surveillance data to illustrate data manipulation techniques and interpretation procedures as they affect the investigatory environmental surveillance program. (auth)

FUELS PRODUCTION AND PROPERTIES

00021 (ORNL-TM—4917) **Conceptual design of the special nuclear material nondestructive assay and accountability system for the HTGR fuel refabrication pilot plant.** Jenkins, J.D.; McNeany, S.R.; Rushton, J.E. (Oak Ridge National Lab.; Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 135p. Dep. NTIS $5.45.

The conceptual design of the fissile material assay and accountability system for the HTGR refabrication pilot plant has been established. The primary feature affecting the design is the high, time varying, gamma activity of the process material due to the unavoidable presence of uranium-232. This imposes stringent requirements for remote operation and remote maintainability of system components. At the same time, the remote operation lends itself to implementation of an automated data collection and processing system for real-time accountability. The high time-varying gamma activity of the material also precludes application of a number of techniques presently employed for light-water reactor fuel assay. The techniques selected for application in the refabrication facility are (1) active thermal neutron interrogation with fast-fission or delayed-neutron counting for fuel-rod and small-sample assay, (2) calorimetry for high-level waste assay, and (3) passive gamma scanning for low-level waste assay, and rapid on-line relative rod-loading measurements. The principal nondestructive assay

subsystems are identified as (1) on-line devices for 100 percent product fuel rod assay and quality control, (2) a multipurpose device in the sample inspection laboratory for small- sample assay and secondary standards calibration, and (3) equipment for assay of high- and low-uranium content scrap and waste materials. A data processing system, which coordinates data from these subsystems with information from other process control sensors, is included to provide real-time material balance information. (auth)

00022 (ORNL-TM—4989) **Effects of processing variables on HTGR fuel kernels fabricated from uranium-loaded cation-exchange resin.** Johnson, D.R.; Lackey, W.J.; Sease, J.D. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 28p. Dep. NTIS $4.00.

An experiment was performed to determine whether the process for refabricating HTGR fuel kernels could be reasonably controlled if scaled up to batches of 500 g U in a 5-in. ID (0.13-m) microsphere coating furnace. The effects of gas flow rate, heating rate, and resin conversion temperature and time on the composition, size, shape, and density of the fuel kernels were determined in a statistically designed and analyzed experiment. Based on these results, the uncertainties in predicted values of the fuel kernels at 95 percent confidence are as follows: percent conversion to UC_2, +-15 percent; percent diametral shrinkage, +-2.8 percent; and particle density, +-0.04 g/cm^3. These 95 percent confidence intervals for predicted values can be reduced in magnitude via more experimental data. The process can be controlled within acceptable limits in engineering-scale equipment. (auth)

00023 **Oxynitride fuel kernel for gas-cooled reactor fuel particles.** Leitnaker, J.M.; Lindemer, T.B. (to U.S. Energy Research and Development Administration). US Patent 3,878,041. 15 Apr 1975. Filed date 8 Aug 1973. 9p.

PAT-APPL-386,657.

A nuclear fuel for use in gas-cooled reactors comprising a carbon coated kernel of UO/sub 2-r/N/sub 3/4x/ where 0 less than x less than or equal to 1 is described. (auth)

00024 **Method of making microspheroidal nuclear fuels having closed porosity.** Googin, J.M.; Schmitt, C.R. (to U.S. Energy Research and Development Administration). US Patent 3,880,769. 29 Apr 1975. Filed date 19 Dec 1972. 8p.

PAT-APPL-316,625.

A process is described for the preparation of microspheroidal particles comprising absorbing uranium cations from a uranyl aqueous solution onto small spherical ion exchange resin particles, drying the uranium-loaded resin, and then carbonizing the dried resin to form a porous carbon spheroid having closed porosity with an oxide or carbide of uranium uniformly dispersed within its volume. The same general technique can be used to form microspheres of the oxides or carbides of other actinide metals. (auth)

00025 **Porous, microspheroidal, nuclear fuels having internal porosity.** Googin, J.M.; Schmitt, C.R. (to U.S. Energy Research and Development Administration). US Patent 3,887,486. 3 Jun 1975. Filed date 16 Oct 1972. 8p.

PAT-APPL-298,134.

A process is described for the preparation of microspheroidal particles comprising absorbing uranium cations from a uranyl aqueous solution onto small spherical ion exchange resin particles, drying the uranium-loaded resin, and then carbonizing the dried resin to form a porous carbon spheroid having closed porosity with an oxide or carbide or uranium uniformly dispersed within its volume. The same general technique can be used to form microspheres of the oxides or carbides of other actinide metals. (auth)

00026 **Method for electrodeposition of nickel—chromium alloys and coating of uranium.** Stromatt, R.W.; Lundquist, J.R. (to U.S. Energy Research and Development Administration). US Patent 3,888,744. 10 Jun 1975. Filed date 24 Oct 1974. 6p.

PAT-APPL-517,663.

High-quality electrodeposits of nickel-chromium binary alloys in which the percentage of chromium is controlled can be obtained by the addition of a complexing agent such as ethylenediaminetetraacetic disodium salt to the plating solution. The nickel-chromium alloys were found to provide an excellent hydrogen barrier for the protection of uranium fuel elements. (auth)

00027 **Means for effecting fluidization in pyrolytic carbon coating processes.** Lackey, W.J. Jr.; Sease, J.D. (to U.S. Energy Research and Development Administration). US Patent 3,889,631. 17 Jun 1975. Filed date 18 Mar 1974. 11p.

PAT-APPL-452,166.

An improved gas distribution means, which has utility in fluidized bed coaters for depositing pyrolytic carbon, is described. It consists of a plurality of gas-permeable regions within a supporting matrix comprising a relatively thick dimension for structural rigidity and relatively thin sections to inhibit clogging due to decomposition products of the fluidizing gas. A second gas distribution means feeds gas into a plenum below said first gas distribution means to insure a uniform pressurized zone of gas which serves as feed to said gas-permeable regions. (auth)

00028 **Measurement and control of shape of fuel particles for high temperature gas-cooled reactors.** Lackey, W.J.; Pechin, W.H.; Sease, J.D. (Oak Ridge National Lab., TN). *Am. Ceram. Soc. Bull.*; 54: No. 8, 718-724(Aug 1975).

From 76. Annual meeting of the American Ceramic Society; Chicago, IL (29 Apr 1974).

A rapid and meaningful technique for measuring the shape or out-of-roundness of coated fuel microspheres was developed. The index of merit is termed shape ratio and is defined as the coating thickness on one side of a particle divided by the thickness on the opposite side. More nearly spherical particles were obtained by coating in smaller charges, at higher propylene flow rates, at lower temperatures and with a porous plate rather than a single-inlet cone used as the gas distributor for the fluidized bed. (auth)

SPENT FUELS REPROCESSING

00029 (BNWL—1907) **Technical and economic feasibility of partitioning Hanford Purex Process acid waste.** Burns, R.E.; Hartley, J.N.; Lester, D.H.; Roberts, F.P.; Swanson, J.L.; Wheelwright, E.J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-1830. 57p. Dep. NTIS $7.60.

A study was made of the technical and economic feasibility of applying the concept of partitioning to Hanford Purex process acidic high-level waste. Partitioning, as used here, means separating from the bulk waste a fraction containing long-lived (greater than 100 years, half-life) radionuclides. Relatively low separation factors are required to achieve the actinide element concentrations in the short-lived fraction which were considered in this study. A parametric study involving a series of residual actinide element concentrations in the short-lived waste fraction was made. These concentrations ranged from 1 etaCi to 10^4 etaCi per gram of solidified waste. Flowsheets were developed which are based on existing technology and which are considered to have good probability of achieving the required actinide element separations. Preliminary cost estimates were made for implementing these separations schemes into the Hanford Purex plant and B-plant complex. (JGB)

00030 (BNWL-SA—5501) **Development of disposition criteria deviation methodology for commercial fuel cycle facilities.** Waite, D.A.; Jenkins, C.E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract AT(45-1)-1830. 21p. Dep. NTIS $4.25.

Development and definition of acceptable criteria for release of nuclear sites and/or facilities under specified use restriction categories or disposition criteria are discussed. Previous reports have defined site and facility characteristics before major decontamination or decommissioning. With this background information, disposition criteria were developed to facilitate decision-making regarding disposition alternatives. To develop these disposition criteria, existing guidance was reviewed, philosophy and objectives were identified, and mechanisms were developed and applied to a generic mixed oxide fuel fabrication plant. (auth)

00031 (CONF-750822—6) **Status of ANSI standards on decommissioning of nuclear reprocessing facilities.** Graham, H.B. (Oak Ridge National Lab., Tenn. (USA)). 1975. 7p. Dep. NTIS $4.00.

From 14. international conference on low temperature physics; Otaniemi, Finland (14 Aug 1975).

A definition of decommissioning is given, and the preparation of ANSI Standard, "General Design Criteria for Nuclear Reprocessing Facilities" (N101.3) is discussed. A Eurochemic report, entitled "The Shutdown of Reprocessing Facilities—Results of Preliminary Studies on the Installations Belonging to Eurochemic," was used in the preparation of this standard. (LK)

00032 (CONF-750913—9) **Removal of actinides from high-level wastes generated in the reprocessing of commercial fuels.** Bond, W.D.; Leuze, R.E. (Oak Ridge National Lab., Tenn. (USA)). Sep 1975. 21p. Dep. NTIS $4.25.

From 4. international transplutonium elements symposium; Baden-Baden, F.R. Germany (13 Sep 1975).

Progress is reported on a technical feasibility study of removing the very long-lived actinides (uranium, neptunium, plutonium, americium, and curium) from high-level wastes generated in the commercial reprocessing of spent nuclear fuels. The study was directed primarily at wastes from the reprocessing of light water reactor (LWR) fuels and specifically to developing satisfactory methods for reducing the actinide content of these wastes to values that would make 1000-year-decayed waste comparable in radiological toxicity to natural uranium ore deposits. Although studies are not complete, results thus far indicate the most promising concept for actinide removal includes both improved recovery of actinides in conventional fuel reprocessing and secondary processing of the high-level wastes. Secondary processing will be necessary for the removal of americium and curium and perhaps some residual plutonium. Laboratory-scale studies of separations methods that appear most promising are reported and conceptual flowsheets are discussed. (auth)

00033 (HEDL-TME—75-31) **Plutonium partitioning in the Purex process with hydrazine-stabilized hydroxylamine nitrate.** Richardson, G.L.; Swanson, J.L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1975. Contract AT(45-1)-2170. 92p. Dep. NTIS $5.45.

The use of hydrazine-stabilized hydroxylamine nitrate (HAN) to partition plutonium from uranium in the Purex process was successfully demonstrated in a laboratory multistage contactor. Reduction rate constants for the HAN-Pu(IV) reaction were obtained and used in a generally satisfactory computer simulation of the partition behavior. (auth)

00034 (ICP—1073) **Evaluation of a continuous solid bowl centrifuge for processing simulated Rover dissolver effluent.** Vavruska, J.S.; Rindfleisch, J.A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Jun 1975. Contract E(10-1)-1375. 23p. Dep. NTIS $4.00.

Pilot-plant studies using a plant-scale continuous Bird centrifuge were made to determine the solids—liquid separation and subsequent solids washing efficiencies for processing simulated Rover dissolver effluent. The studies were undertaken to provide a basis for acceptance of the continuous solid bowl centrifuge as a method of solids—liquid separation and solids washing in the Rover process. Test results showed the solid bowl centrifuge reduced the undissolved solids content of the liquid effluent to a level compatible with the TBP extraction system in the range of flow rates studied. Although wash injection nozzles were located within the centrifuge bowl, little or no washing of occluded uranium from the solids was possible. The most effective removal of occluded uranium, and thus the most efficient uranium recovery, resulted from repulping undissolved solids in water in two or more stages and recycling the repulped slurry through the centrifuge. Discharged solids were in the form of a fluid mass after the initial centrifugation and all subsequent repulp stages. Pilot-plant experience indicates the plant centrifuge should operate satisfactorily under remote conditions. Troublefree operation should result if there is no significant deviation from process conditions specified in the Rover flow sheet and operating procedures outlined. (auth)

00035 (RL-SEP—352) **Operational report on the Purex Plant Thorium Process Test.** Duckworth, J.P.; Harlow, D.G.; Herrington, C.C. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 15 Mar 1965. Contract AT(45-1)-2130. 76p. Dep. NTIS $7.00.

The Purex Plant Thorium Process Test was successfully completed February 10, 1965, after 25 days of processing. The three special products were: 2886 g of ^{233}U, 7660 lb of Th, and 4 g of ^{232}Pa. The ^{233}U was 95.5 percent pure. The test demonstrated that irradiated thoria fuel can be processed efficiently in the Purex Plant. (LK)

00036 (UCRL—51802(Pt.1)) **Evaluation of methods for seismic analysis of nuclear fuel reprocessing plants, part 1.** Tokarz, F.J.; Murray, R.C.; Arthur, D.F.; Feng, W.W.; Wight, L.H.; Zaslawsky, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Feb 1975. Contract W-7405-Eng-48. 80p. Dep. NTIS $5.45.

Currently, no guidelines exist for choosing methods of structural analysis to evaluate the seismic hazard of nuclear fuel reprocessing plants. This study examines available methods and their applicability to fuel reprocessing plant structures. The results of this study should provide a basis for establishing guidelines recommending methods of seismic analysis for evaluating future fuel reprocessing plants. The approach taken is: (1) to identify critical plant structures and place them in four categories (structures at or near grade; deeply embedded structures; fully buried structures; equipment/vessels/attachments/piping), (2) to select a representative structure in each of the first three categories and perform static and dynamic analysis on each, and (3) to evaluate and recommend method(s) of analysis for structures within each category. The Barnwell Nuclear Fuel Plant is selected as representative of future commercial reprocessing plants. The effect of site characteristics on the structural response is also examined. The response spectra method of analysis combined with the finite element model for each category is recommended. For structures founded near or at grade, the lumped mass model could also be used. If a time history response is required, a time-history analysis is necessary. (auth)

00037 (BNWL-tr—149) **Reprocessing of thorium-containing nuclear fuels. Annual activity report, July 1, 1973—June 30, 1974.** Laser, D.M. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Chemische Technologie). 1974. Translated from a German report. 13p. Dep. NTIS $4.00.

Treatment of radioactive off-gases and highly radioactive wastes by solidification is discussed. Installation of the solidification facility in the chemistry cells was completed, and partial testing and complete cold tests were carried out. (LK)

00038 (GERHTR—136) **Treatment of volatile radionuclides in nuclear fuel reprocessing plants.** Boehnert, R. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Chemische Technologie). Jul 1974. Translation of JUL—1089-CT. 30p. Dep. NTIS $4.50.

Work performed under United States—German High Temperature Reactor Research Exchange Program.

The volatile radionuclides produced during the utilization of nuclear energy pass into the reprocessing plant with the spent fuel elements. Here the radionuclides are volatilized during fuel element disintegration, during heavy metal dissolution and during the process stage of the solidification of highly radioactive fission product solutions in process-dependent quantities. These quantities exceed, at least locally, the permissible limiting concentrations and may not therefore be released unchecked into the biosphere. The volatile radionuclides occur in the form of aerosols, vapors and gases and undergo specific separation at their site of origin by means of known processes, which are predominantly borrowed from conventional gas purification technology. By enclosure of the separated volatile radionuclides in gas-tight containers, after fixation by adsorption and absorption in solids or liquids, they can in accordance with the present state of the technology be safely sent for ultimate storage. Further studies will have to be made in the future of possible methods for the best form of ultimate storage. (auth)

00039 **Method for dissolving ceramic beryllia.** Sands, A.E. (to U.S. Energy Research and Development Administration). US Patent 3,879,520. 22 Apr 1975. Filed date 31 Jan 1963. 10p.

PAT-APPL-255,740.

A process is described for dissolving a nuclear fuel composition consisting of a sintered mass containing beryllia, a nuclear fuel selected from uranium and plutonium and a stabilizing agent, sintered at a temperature of at least 1500°C to a density of about 2.7 gs/cc. The process comprises contacting said sintered mass with a stoichiometric excess of lithium oxide dissolved or dispersed in a carrier selected from lithium hydroxide, sodium hydroxide or sodium nitrate at a temperature in the range 750—850°C to convert the beryllia to lithium beryllate and thereafter recovering the nuclear fuel content of said mass. (auth)

TRANSPORT AND STORAGE

00040 (BNWL-SA—5314) **Safety analysis of the transportation of high-level radioactive waste.** Murphy, E.S.; Winegardner, W.K. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract AT(45-1)-1830. 17p. (CONF-750607—26). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

An analysis of the risk from transportation of solidified high-level waste is being performed at Battelle-Northwest as part of a comprehensive study of the management of high-level waste. The risk analysis study makes use of fault trees to identify failure events and to specify combinations of events which could result in breach of containment and a release of radioactive material to the environment. Contributions to risk analysis methodology which have been made in connection with this study include procedures for identification of dominant failure sequences, methods for quantifying the effects of probabilistic failure events, and computer code development. Preliminary analysis based on evaluation of the rail transportation fault tree indicates that the dominant failure sequences for transportation of solidified high-level waste will be those related to railroad accidents. Detailed evaluation of rail accident failure sequences is proceeding and is making use of the limited frequency-severity data which is available in the literature. (auth)

00041 (SAND—75-0248) **Transportation environment data bank index.** Davidson, C.A.; Foley, J.T. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jun 1975. Contract AT(29-1)-789. 37p. Dep. NTIS $4.00.

In an effort to determine the environmental intensities to which shipping containers will be exposed, a "Data Bank" of environmental information has been established by Sandia Laboratories, Division 1542, for the ERDA Division of Waste Management and Transportation. This document is an index which can be used to request data of interest. (auth)

MARKETING AND ECONOMICS

00042 (ORNL-TM—4743) **Reconnaissance survey of the intermediate level liquid waste transfer line between X-10 and the hydrofracture site.** Duguid, J.O.; Sealand, O.M. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 24p. Dep. NTIS $4.25.

Two leakage points on an intermediate-level liquid waste line were located. The waste line is used periodically to transfer waste between X-10 and the hydrofracture site. The first leak had occurred prior to this survey and had been repaired. However, no contaminated soil had been removed. The second leak had not been discovered previously and soil contamination in this area was more intense than at the first leak. Analyses of soil samples taken from both locations are given in this report. Groundwater data that indicate the effectiveness of the removal of the contaminated material from leak two are presented. (auth)

WASTE MANAGEMENT

00043 (BNWL-B—424) **Decision model incorporating utility theory and measurement of social values applied to nuclear waste management.** Litchfield, J.W.; Hansen, J.V.; Beck, L.C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-1830. 58p. Dep. NTIS $5.45.

A generalized computer-based decision analysis model was developed and tested. Several alternative concepts for ultimate disposal have already been developed; however, significant research is still required before any of these can be implemented. To make a choice based on technical estimates of the costs, short-term safety, long-term safety, and accident detection and recovery requires estimating the relative importance of each of these factors or attributes. These relative importance estimates primarily involve social values and therefore vary from one individual to the next. The approach used was to sample various public groups to determine the relative importance of each of the factors to the public. These estimates of importance weights were combined in a decision analysis model with estimates, furnished by technical experts, of the degree to which each alternative concept achieves each of the criteria. This model then integrates the two separate and unique sources of information and provides the decision maker with information as to the preferences and concerns of the public as well as the technical areas within each concept which need further research. The model can rank the alternatives using sampled public opinion and techno-economic data. This model provides a decision maker with a structured approach to subdividing complex alternatives into a set of more easily considered attributes, measuring the technical performance of each alternative relative to each attribute, estimating relevant social values, and assimilating quantitative information in a rational manner to estimate total value for each alternative. Because of the explicit nature of this decision analysis, the decision maker can select a specific alternative supported by clear documentation and justification for his assumptions and estimates. (JGB)

00044 (Y-DA—6225) **Scaleup of GRAPHNOL at Y-12.** Pollock, C.B.; Overholser, L.G. (Oak Ridge Y-12 Plant, Tenn. (USA)). [nd]. Contract W-7405-eng-26. 7p. (CONF-750322—1). Dep. NTIS $4.00.

From Conference on navy strategic systems exploratory development programs review; Silver Spring, Maryland, USA (18 Mar 1975).

GRAPHNOL graphite is based on the use of low-fired filler or green cokes that behave like a sinterable ceramic, yielding a monolithic graphite structure after final firing. A study was made of the feasibility of scaling the process to yield full-size blocks in a reproducible manner. About 20 full-size billets were fabricated, many of which have slight defects (chipped edges, small surface cracks), but the majority of the billets are sound. The final density is not yet satisfactory, and impregnation is being attempted. Defects relating to segregation of fines is now the major priority. (DLC)

00045 **Critical experiments-benchmarks (Pu—U systems).** Bierman, S.R. (Battelle Pacific Northwest Labs., Richland, WA). *Nucl. Technol.*; **26**: No. 3, 352-381(Jul 1975).

Fourteen different critical systems of plutonium-uranium homogeneous mixtures are arranged in a format amenable for use in validating calculational techniques and checking nuclear data. Each experimental system is completely defined under a single benchmark number. For the data that permit it, multiple critical dimensions are given for each fuel composition and geometry. Wherever possible, experimentally determined correction factors are provided for reducing the complexity of the critical assemblies. (auth)

00046 **Nominally reflected pipe intersections containing fissile solution.** Dickinson, D. (Dow Chemicals, Golden, CO). *Nucl. Technol.*; **26**: No. 3, 265-277(Jul 1975).

Monte Carlo calculations for pipe intersections containing highly enriched, concentrated uranyl nitrate solution and reflected by a concrete room provide safe pipe diameters for a range of room sizes. The pipe-wall material (steel, aluminum, or Plexiglas) has a small effect on k/sub eff/ for 0.125-in.-thick pipes. Replacing the uranyl nitrate solution by uranyl fluoride results in a large increase in k/sub eff/, and using plutonium nitrate (3 percent ^{240}Pu) lowers k/sub eff/. Reflector savings curves for water and for concrete around an infinite cylinder of uranyl nitrate solution show that thick concrete is a much better reflector than an equal thickness of water. The calculational data are summarized in the form of a table and a set of rules for the use of the table in the calculation of safe dimensions for a system of intersecting pipes. This method is also applicable to plutonium systems if the plutonium contains at least 3 wt percent ^{240}Pu and no ^{241}Pu. (auth)

00047 **Rocky Flats experience with borosilicate glass rings for criticality control.** Schuske, C.L.; McCarthy, J.D. (Dow Chemicals, Golden, CO). *Nucl. Technol.*; **26**: No. 3, 254-264(Jul 1975).

The large scale use of borosilicate glass raschig rings for the storage of plutonium nitrate and enriched uranyl nitrate solutions began at the Rocky Flats Plant (RFP) in 1959. Much has been learned since that date in the use of these rings. Some of the problems encountered with raschig rings are (a) corrosion of rings; (b) settling of the rings; (c) chipping and cracking which have led to pump and drainage problems; (d) silicious deposits on the rings in the storage of uranium solutions; (e) plutonium oxide sludge deposits on rings; and (f) the problem of completely filling conventional domed tanks. Solutions to most of these problems have been found; however, problems (a) and (e) are receiving additional attention at RFP. (auth)

WASTE PROCESSING

00048 (ARH—2656B) **Atlantic Richfield Hanford Company semiannual report, 02 process development, November 1, 1972—April 30, 1973.** Hopkins, H.H. Jr. (ed.). (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Jun 1973. Contract AT(45-1)-2130. 60p. Dep. NTIS $6.00.

Dissolution capability, solvent extraction and ion exchange, incineration capability, and instrumentation improvement are covered in the plutonium scrap processing section. The waste management section covers solidification and encapsulation and public protection assurance. (LK)

00049 (ARH-ST—110C) **Waste Management and Transportation Technology Development. Quarterly report, January 1975—March 1975.** Kupfer, M.J.; Van Slyke, W.J. (eds.). (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2130. 149p. Dep. NTIS $5.75.

Progress is reported in support of management of Hanford high-level wastes. The work reported here was performed during the period January through March 1975. The specific topics discussed are grouped into the subject areas of: salt cake retrieval, tank integrity; storage system improvements; waste immobilization; and preparation of failed, contaminated equipment for disposition. (auth)

00050 (DP—1388) **Removal of cesium from Savannah River Plant waste supernate.** Wiley, J.R.; Wallace, R.M. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jul 1975. Contract AT(07-2)-1. 19p. Dep. NTIS $4.00.

A process for separation and concentration of ^{137}Cs from Savannah River Plant waste supernate by using Duolite ARC-359 cation exchange resin was demonstrated with both synthetic and actual wastes. Tracer-level studies showed that Duolite resin efficiently sorbed cesium from a solution with composition expected for the plant process and that the resin could be cycled (load-elute-regenerate) repeatedly without damage. In column tests using actual waste supernates greater than 99.99 percent of the ^{137}Cs was removed. Column throughput was correlated with feed composi-

tion by an empirical model. ^{137}Cs, eluted from the Duolite columns, was sorbed on zeolite for final solidification in concrete or glass. The overall volume reduction factor from cesium-salt solution to cesium-zeolite product is about 1400. Linde AW-500 zeolite sorbed cesium directly from waste salt solutions. Direct sorption is not recommended because 40 times more cesium-zeolite would be produced than by the Duolite process. (auth)

00051 (DP—1389) **Evaluation of mineralization processes for SRP wastes.** Thompson, G.H. (Savannah River Ecology Lab., Aiken, S.C. (USA)). Jul 1975. 19p. Dep. NTIS $4.00.

High level radioactive wastes at the Savannah River Plant (SRP) consist of an insoluble sludge containing most of the actinides and fission products except cesium, and of a supernate (or soluble salt) containing most of the cesium. One option for long term management of these wastes is separation of the sludge and the cesium from a relatively nonradioactive residue followed by solidification and storage. Mineralization or a possible method of solidification were investigated. The study demonstrates the fixation of cesium in zeolite and aluminosilicate minerals and sludge reactions with sodium hydroxide and silica gel. Results of the study show that cesium removed from waste supernate can be fixed in zeolite; cesium leachability was approximately 4×10^{-6} g/(cm^2-day). Sodalite and cancrinite can be prepared by reacting alkaline cesium-containing waste with kaolinite. Volume increases were up to 285 times that of the zeolite product, and leachabilities were at least 10^4 times that of the zeolite product. Leachabilities were not improved by firing sodalite and cancrinite at 1000°C to form carnegieite and nepheline. Pollucite was produced by reaction of cesium with bentonite and kaolinite. However, not all the cesium reacted, and the product is a powder. Gamma doses of 10^{10} rads did not affect the cesium leachabilities or product volumes of the minerals. Simulated sludge is solidified, not mineralized, by reaction with NaOH and silica gel. The product is a hard, friable monolith occupying 2 to 5 times the original sludge volumes; preliminary strontium leachabilities were 5×10^{-7} g/(cm^2-day). (auth)

00052 (HEDL-SA—963) **Waste volume reduction by acid digestion.** Lerch, R.E.; Divine, J.R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1975. Contract AT(45-1)-2170. 32p. (CONF-750902—8). Dep. NTIS $4.75.

From 80. national meeting of the American Institute of Chemical Engineers; Boston, Massachusetts, USA (7 Sep 1975).

Acid digestion is a process being developed at the Hanford Engineering Development Laboratory (HEDL) in Richland, Washington, to reduce the volume of alpha-contaminated combustible waste by converting it into a non-combustible residue. Typical waste materials such as polyvinylchloride (PVC), polyethylene, paper and other cellulosic materials, ion exchange resin, all types of rubber, etc., are digested in hot (230°C—270°C) concentrated sulfuric acid containing nitric acid oxidant to form inert residues generally having less than four percent of their original volume and less than twenty-five percent of their original mass. The process is currently being tested using non-radioactive waste in an Acid Digestion Test Unit (ADTU) with all glass equipment. Engineering tests to date have shown acid digestion to be a potentially attractive method for treating combustible waste materials. Based on results of the engineering tests, an acid digestion pilot unit capable of treating radioactive wastes is being designed and constructed. Design capacity of the pilot unit for radioactive waste will be 100 kg of waste per day. (auth)

00053 (ICP—1075) **Fluidized-bed calcination of simulated high-level commercial wastes. Interim report.** Freeby, W.A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Jun 1975. Contract AT(10-1)-1375. 41p. Dep. NTIS $4.00.

Experimental results on the development of flowsheets for the calcination of commercial high and intermediate-level waste are reported. (auth)

00054 (ICP—1078) **Volatile ruthenium removal from calciner off-gas using solid sorbents.** Newby, B.J.; Barnes, V.H. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Jul 1975. Contract E(10-1)-1375. 56p. Dep. NTIS $5.45.

Laboratory studies were made to find the most effective solid sorbent for removing volatile ruthenium from calciner off-gas. Silica gel is now used for volatile ruthenium removal in the Waste Calcining Facility (WCF) located at the Idaho Chemical Processing Plant (ICPP). Silica gel was again selected as the most effective solid sorbent for removing volatile ruthenium, and operating conditions were defined for maximizing silica gel effectiveness. (auth)

00055 (LA—5993-MS) **Characterization of transuranic solid wastes from a plutonium processing facility.** Mulkin, R. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1975. 24p. Dep. NTIS $4.00.

Transuranic-contaminated wastes generated in the processing areas of the Plutonium Chemistry and Metallurgy Group at the Los Alamos Scientific Laboratory (LASL) were studied in detail to identify their chemical and physical composition. Nondestructive Assay (NDA) equipment was developed to measure transuranic activity at the 10-nCi/g level in low-density residues typically found in room-generated waste. This information will supply the Waste Management Program with a more positive means of identifying concerns in waste storage and the challenge of optimizing the system of waste form, packaging, and environment of the storage area for 20-yr retrievable waste. A positive method of measuring transuranic activity in waste at the 10-nCi/g level will eliminate the need for administrative control in a sensitive area, and will provide the economic advantage of minimizing the volume of waste stored as retrievable waste. (auth)

00056 (MLM—2217) **Tritium effluent control project. Progress report, October—December 1974.** Kershner, C.J. (Mound Lab., Miamisburg, Ohio (USA)). 25 Aug 1975. Contract E-33-1-GEN-53. 23p. Dep. NTIS $4.00.

Installation of the pilot-scale cryogenic adsorbate separation system in the new Tritium Effluent Control Laboratory is beyond 50 percent completion. In the hydrogen gettering study, HIP alloy was found to sorb 2.2 wt percent hydrogen at room temperature. The possibilities for tritium decontamination by molecular excitation were investigated. The best scheme for tritium removal was determined to be selective photodissociation of HTO in the presence of H_2. Three additional materials were evaluated for use in an extractive distillation system for tritiated liquid waste decontamination. A computer program was developed for calculating operating and design parameters for catalytic exchange enrichment and stripping of tritiated water. (LK)

00057 (MLM—2235) **Tritium effluent control project. Progress report, January—March 1975.** Kershner, C.J.; Bixel, J.C. (Mound Lab., Miamisburg, Ohio (USA)). 27 Aug 1975. Contract E-33-1-GEN-53. 28p. Dep. NTIS $4.00.

The 100-cfm, pilot-scale helium purification unit was installed in the Tritium Effluent Control Laboratory. Hydrogen-HIP alloy isotherm data were obtained at 28, 200, 400, and 600°C. In order to more clearly define the frequency and power of IR radiation required for the molecular excitation scheme, a study of the HDO IR spectrum was undertaken. The continuing theoretical analysis of the H_2O/H_2 system led to three major results: (1) the isotope effects on the key reactions in the H_2O/H_2 system were calculated and will be used to model the kinetics of the scavenging process; (2) the rate of the exchange reaction, $T + H_2O$ yields $HTO + H$, was analyzed with a simple theoretical model and shown to be extremely slow relative to the exchange reaction, $T + H_2$ yields $HT + H$; and (3) the effect of tritium β decay on the H_2O/H_2 system was calculated in a qualitative manner. (LK)

00058 (UCID—16833) **Proposed pressure vessel concept and design for tritium gas for operation to pressures of 68.95 MPa (680.5 atm) and temperatures to 1000°C.** Lakner, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jul 1975. Contract W-7405-Eng-48. 42p. Dep. NTIS $5.25.

A proposed design for a pressure vessel to contain thermally hot tritium is described. It is a lined cylinder (4 in. id by 7.5 in. od by 17$^1/_8$ in. working depth) designed for operation to pressures of 68.95 MPa (680.5 atm) and to temperatures of 1000°C. Since these conditions do not allow for external heating, due to reduced strength of alloys and high gas-permeation rates at high pressures and temperatures, it is necessary to use internal heaters. In order to keep the amount of T_2 to a minimum for any particular experiment, it was decided to design a system where the T_2 would be contained in a small pressure vessel situated within a larger pressure vessel, with the internal pressure balanced externally with a nonradioactive gas. An additional advantage of such a system is that the specimen under T_2 does not "see" the heater environment and so contamination of the specimen is reduced. However, the converse is not true. The heater will "see" some T_2 due to diffusion through the inner container wall, the amount depending on pressure, temperature, and duration of the particular experiment. (auth)

00059 **Improved process for calcining radioactive wastes containing sodium nitrate.** Newby, B.J. (to U.S. Energy Research and Development Administration). US Patent Application544,741. Filed date 28 Jan 1975. 12p.

Particle agglomeration during fluidized bed calcination of liquid acidic radioactive wastes containing sodium nitrate is prevented by the addition of iron to the acidic liquid waste before

calcining. The calcine formed is inert and can be further processed for solid waste storage. (auth)

00060 Method of converting nuclear-fuel wastes to an inert solid. Berreth, J.R. (to U.S. Energy Research and Development Administration). US Patent Application528,766. Filed date 2 Dec 1974. 6p.

Predominantly sodium-containing nuclear-fuel wastes (either in liquid or solid form) are converted to an inert solid material by adding a slight excess with respect to the formation of albite ($Na_2O.Al_2O_3.6SiO_2$) of alumina and silica to the wastes and sintering the mixture at 800 to 1100°C to form albite. Alumina may be added as hydrated kaolinic clay and silica as silica sand. (auth)

00061 Solid sorbent for trapping iodine. Richardson, D.M.; Bamberger, C.E. (to U.S. Energy Research and Development Administration). US Patent 3,880,619. 29 Apr 1975. Filed date 5 Sep 1974. 6p.

PAT-APPL-503,238.

Lead monoxide is used as a sorbent for iodine. (auth)

00062 Silicon removal from incinerator ash by reaction with NOF.3HF. Auge, R.G.; DeGrazio, R.P. (to U.S. Energy Research and Development Administration). US Patent 3,882,040. 6 May 1975. Filed date 21 Jun 1973. 6p.

PAT-APPL-372,134.

Incinerator ash containing silicon is contacted with nitrosyl fluoride trihydrogen fluoride (NOF.3HF) converting silicon present to silicon tetrafluoride (SiF_4) gas, thereby minimizing formation of gelatinous silica polymer in subsequent treatment of the ash to recover plutonium, americium, and the like. (auth)

00063 Industrial technique. Robertson, D.H. (to U.S. Energy Research and Development Administration). US Patent 3,887,339. 3 Jun 1975. Filed date 19 Nov 1973. 13p.

PAT-APPL-417,434.

Techniques for selectively extracting and storing only krypton and xenon in the waste gases that are released from a pressurized water nuclear power reactor are described. The illustrative fluorocarbon absorption system has three separation stages: an initial gas-fluorocarbon absorber, a flash chamber and fractionator for segregating all of the absorbed gases from the loaded absorber stage fluorocarbon (save for the krypton and xenon), and a stripper that receives the partially loaded fluorocarbon liquid directly from the fractionator in order to separate only the krypton and xenon. A molecular sieve filter dries the input process gas, a cartridge type solvent filter is used to remove radiation degradation products from the loaded liquid that flows from the absorber, a cold trap gas drier is provided to remove residual solvent vapor from the separated krypton and xenon, and radiation detectors automatically activate valves to establish safe conditions in the event of an accident or plant failure. (auth)

00064 Noble gas absorption process. Thomas, J.W. (to U.S. Energy Research and Development Administration). US Patent 3,890,121. 17 Jun 1975. Filed date 19 Feb 1974. 15p.

PAT-APPL-443,262.

A method of removing a noble gas from air comprising the use of activated carbon filters in stages in which absorption and desorption steps in succession are conducted in order to increase the capacity of the filters is described. (auth)

WASTE DISPOSAL AND STORAGE

00065 (ARH-CD—133C) **Production and waste management division waste status summary. Progress report, 1 July 1974—30 September 1974.** Anderson, J.D. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 27 Nov 1974. 12p. Dep. NTIS $4.00.

Tabulated data on the status of waste farms and the performance of the waste solidification system are included. (JGB)

00066 (ARH-SA—218) **Immobilization of aqueous radioactive cesium wastes by conversion to aluminosilicate minerals.** Barney, G.S. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2130. 34p. (CONF-750673—1). Dep. NTIS $4.25.

From 30. northwest regional meeting American Chemical Society; Honolulu, Hawaii, USA (12 Jun 1975).

Radioactive cesium (primarily ^{137}Cs) is a major toxic constituent of liquid wastes from nuclear fuel processing plants. Because of the long half-life, highly penetrating radiation, and mobility of ^{137}Cs, it is necessary to convert wastes containing this radioisotope into a solid form which will prevent movement to the biosphere during long-term storage. A method for converting cesium wastes to solid, highly insoluble, thermally stable aluminosilicate minerals is described. Aluminum silicate clays (bentonite, kaolin, or pyrophyllite) or hydrous aluminosilicate gels are reacted with basic waste solutions to form pollucite, cesium zeolite (Cs-D), Cs-F, cancrinite, or nepheline. Cesium is trapped in the aluminosilicate crystal lattice of the mineral and is permanently immobilized. The identity of the mineral product is dependent on the waste composition and the SiO_2/Al_2O_3 ratio of the clay or gel. The stoichiometry and kinetics of mineral formation reactions are described. The products are evaluated with respect to leachability, thermal stability, and crystal morphology. (auth)

00067 (ARH-SA—235) **Hydrologic management at the Hanford nuclear waste facility.** Deju, R.A.; Gephart, R.E. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2130. 34p. (CONF-750667—1). Dep. NTIS $4.75.

From 2. international conference on environmental problems of the extractive industries; Dayton, Ohio, USA (15 Jun 1975).

Since 1944 the Hanford Reservation, located in south-central Washington, has been a site for radioactive waste storage and disposal. Many Hanford research programs are directed toward minimizing and managing the release of radionuclides into the environment. Hydrologic management of the Hanford facility involves such activities as regional and local geohydrologic characterization studies, environmental monitoring, groundwater management, and specific hydrologic research programs. This paper briefly examines each of these activities and reviews the progress to date in understanding the hydrologic flow regime existing beneath the Reservation. (auth)

00068 (BNWL—1869) **Corrosion of mild steel tank liners exposed to simulated solidified alkaline high-level waste.** Maness, R.F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1974. Contract AT(45-1)-2130. 15p. Dep. NTIS $4.00.

Mild steel coupons and stressed C-rings exposed to simulated solidified waste for 7, 12, and 22 months exhibited both general and pitting corrosion but no stress corrosion cracking. Weight loss measurements indicated corrosion rates ranging from 0.7 to 4.7 mils/year after 22 months exposure. Corrosion rates were nearly the same for specimens exposed at 60 and 80°C. Corrosion rates at 95°C were about one-half those found at 60 and 80°C. Increasing the water content from 5 to 15 percent increased general corrosion by a factor of about two. Pitting attack occurred on all specimens exposed to high-alkali waste. The pitting rate appeared to be approximately linear with respect to time during the 22-month exposure period. A maximum pit depth of 20 mils was observed. Corrosion of specimens exposed to waste prepared from solutions in which the caustic content had been largely neutralized with phosphoric, sulfuric, or nitric acid was very light, greater than .01 to 0.6 mils/year with no pitting. (auth)

00069 (BNWL—1885) **Avifauna of waste ponds ERDA Hanford Reservation, Benton County, Washington.** Fitzner, R.E.; Rickard, W.H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1975. Contract AT(45-1)-1830. 96p. Dep. NTIS $7.60.

The presence of small ponds on the Hanford 200 Area plateau provides attractive habitats for birds. During a 29-month period, 126 bird species were observed utilizing these ponds, their associated vegetation, and air space. Waterfowls are the important agents of dispersal of radionuclides from waste ponds based on food habits, abundance, migratory habits, and importance as food in the diet of people. Abundance, long residence time, and food habits identify the American coot as the single most important species to be considered in the biological dispersal of radionuclides from waste ponds. (auth)

00070 (BNWL—1930) **Techniques for determining mechanical properties of wastes and sampling waste tank contents.** Lawrence. R.C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-1830. 26p. Dep. NTIS $4.00.

At the request of the Atlantic Richfield Hanford Company, Battelle-Northwest developed techniques and equipment for characterizing the radioactive wastes stored in tanks on the Hanford Reservation, for performing in situ tests of waste tank contents, and for sealing perforated wells with an asphaltic emulsion. The equipment and sampling methods developed were shown to be effective for the wide variety of waste materials stored in the Hanford waste tanks. (auth)

00071 (CONF-741001—, pp 64-71) **Analysis of cavity stability by the finite element method.** Anderson, C.A. (Los Alamos Scientific Lab., NM). 1974.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Cube symposium, Lawrence Livermore Laboratory, October 23—25, 1974. Symposium proceedings.

Long term steady state creep of underground structures is a problem of increasing importance by virtue of the implications to

storage of radioactive waste materials and to energy extraction methods which employ underground structures or cavities. This paper describes the axisymmetric finite element code CSAAS which has been developed at the Los Alamos Scientific Laboratory in order to look at these problems. Special attention is directed to the "nearly incompressible" element formulation in CSAAS and to the stable method of time stepping which is used to obtain an estimate of the incompressible steady creep state from an initial elastic solution. Applications are made to thermal creep problems involving pure halite which possesses a well documented creep law of the Weertman form; the flow rule for axisymmetric stress states is based on the Prandtl-Reuss law of metal plasticity. The resulting discretized equations are highly nonlinear. Comparison of the numerical results from CSAAS with the few known analytical solutions to one-dimensional steady creep problems indicates a high degree of accuracy for this finite element method. When applied to the examination of the long term stability of a spherical cavity in halite, various steady motions of the cavity can be observed, depending on the temperature field and the internal pressurization of the cavity. (auth)

00072 (LA-DC—10923) **Safety problems with abandoned explosive facilities.** Courtright, W.C. (Los Alamos Scientific Lab., N.Mex. (USA)). 1969. Contract W-7405-eng-36. 45p. (CONF-690993—1). Dep. NTIS $5.25.

From 11. annual meeting of armed services explosives safety board; Memphis, Tennessee, USA (9 Sep 1969).

Procedures were developed for the safe removal of explosive and radioactive contaminated materials structures and drains from abandoned sites, including explosives processing and service buildings with a goal to return the entire area to its natural state and to permit public access. The safety problems encountered in the cleanup and their solutions are applicable to modification and maintenance work in operating explosive facilities. (PCS)

00073 (LA-UR—75-876) **Relevance of nuclide migration at Oklo to the problem of geologic storage of radioactive waste.** Walton, R.D.; Cowan, G.A. Jun 1975. Contract W-7405-ENG-36. 11p. (CONF-750641—1; SM—204/1). Dep. NTIS $4.00.

From IAEA International symposium on the OKLO phenomenon; Libreville, Gabon (23 Jun 1975).

Analyses of Oklo samples published by French scientists and the data presented by U. S. scientists at this symposium indicate that escape of radioactive products from the Oklo reactor zones was quite limited. Apparently, the major radioactive products that might have been measured in the surrounding environment at the time of the reaction would have been due to ^{85}Kr and, possibly, ^{137}Cs and ^{90}Sr. Other fission product elements which have been significantly displaced over the intervening epochs include Xe, Rb, Ba, Mo, and I. The heavy elements have remained relatively fixed. These conclusions must remain tentative until additional analyses are completed on samples taken near the interfaces between reactor and non-reactor zones. Relevance of these tentative conclusions to other geologic formations must await further study of comparative geochemistry and geology. (auth)

00074 (SAND—74-5855) **Nuclear wastes beneath the deep sea floor.** Bishop, W.P.; Hollister, C.D. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1974. 19p. (CONF-750830—1). Dep. NTIS $4.00.

From 5. international ocean development conference; Tokyo, Japan (3 Aug 1975).

Projections of energy demands for the year 2000 show that nuclear power will likely be one of our energy sources. But the benefits of nuclear power must be balanced against the drawbacks of its by-product: high-level wastes. While it may become possible to completely destroy or eliminate these wastes, it is at least equally possible that we may have to dispose of them on earth in such a way as to assure their isolation from man for periods of the order of a million years. Undersea regions in the middle of tectonic plates and in the approximate center of major current gyres offer some conceptual promise for waste disposal because of their geologic stability and comparatively low organic productivity. The advantages of this concept and the types of detailed information needed for its accurate assessment are discussed. The technical feasibility of permanent disposal beneath the deep sea floor cannot be accurately assessed with present knowledge, and there is a need for a thorough study of the types and rates of processes that affect this part of the earth's surface. Basic oceanographic research aimed at understanding these processes is yielding answers that apply to this societal need. (auth)

ENVIRONMENTAL ASPECTS

00075 (KY—666) **Disposal of hydrogen fluoride and fluorine by gas-liquid dispersion scrubbing.** Story, A.J. (Paducah Gaseous Diffusion Plant, Ky. (USA)). 15 Sep 1975. Contract W-7405-eng-26. 18p. Dep. NTIS $4.00.

A gas—liquid dispersion scrubber was investigated as a method for removing hydrogen fluoride and fluorine from gas streams. Experimental results indicated that the scrubber was greater than 99 percent effective for hydrogen fluoride removal at various concentration levels up to six percent. It is postulated that the scrubber would also be effective at levels greater than six percent. Studies for fluorine removal showed that superficial velocity and fluorine inlet concentration are system variables which produce an interacting effect on the total fluoride in the outlet, and significant quantities of oxygen difluoride are formed at inlet concentrations greater than one percent fluorine. (auth)

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

00076 (ERDA—7) **Societal risk approach to safeguards design and evaluation.** Bennett, C.A.; Murphey, W.M.; Sherr, T.S. (Battelle Human Affairs Research Center, Seattle, Wash. (USA); National Bureau of Standards, Washington, D.C. (USA); Energy Research and Development Administration, Washington, D.C. (USA)). Jun 1975. 63p. Dep. NTIS $5.45.

There has been much discussion and public debate concerning the effectiveness of the national system of safeguards against malevolent acts involving nuclear materials. Useful dialogue on this subject has been hampered by the lack of well-defined objectives, system parameters and boundary conditions as a framework for communication. This study provides such a framework. Expressing the safeguards objective in terms of societal risk represents a change in focus, rather than intent, from the earlier view of safeguards as a system for protecting nuclear material against theft or diversion. The study defines both the safeguards problem and the safeguards system in terms that can be related to the general safeguards objective. It is axiomatic that the first step to an effective solution is a careful definition of the problem. The significant and immediate value of this study lies in the rigorous definition and systematic organization of recognized elements into a coherent and comprehensive pattern. Although the title specifically addresses design and evaluation, the framework provided by the study will be a useful management tool for safeguards implementation and administration as well. (auth)

00077 (SAND—75-0390) **Irradiated fuel bundle counter.** Campbell, J.W.; Todd, J.L. Jr. (Sandia Labs., Albuquerque, N.Mex. (USA); Sandia Labs., Livermore, Calif. (USA)). Jul 1975. Contract AT(29-1)-789. 11p. (CONF-750608—13). Dep. NTIS $4.00.

From Annual meeting of the institute of nuclear materials management; New Orleans, Louisiana, USA (18 Jun 1975).

The design of a prototype safeguards instrument for determining the number of irradiated fuel assemblies leaving an on-power refueled reactor is described. Design details include radiation detection techniques, data processing and display, unattended operation capabilities and data security methods. Development and operating history of the bundle counter is reported. (auth)

00078 (SAND—75-0391) **Physical security system effectiveness evaluation, a status report.** Todd, J.L. Jr.; Nickell, W.C. (Sandia Labs., Albuquerque, N.Mex. (USA); Sandia Labs., Livermore, Calif. (USA)). Jul 1975. Contract AT(29-1)-789. 14p. (CONF-750608—12). Dep. NTIS $4.00.

From Annual meeting of the institute of nuclear materials management; New Orleans, Louisiana, USA (18 Jun 1975).

A method to permit objective comparisons of physical security is under development and is expected to be useful in the optimization of system design and in cost benefit analysis. The procedure involves identifying the possible or potential characteristics of a postulated adversary, the countermeasures to deny or diminish adversary success, and the response capabilities of the defender. These, in conjunction with system definition information, are evaluated by the use of analytical models which provide a means of ranking systems against threats. This paper describes the status of this effort and includes an overview of the methodology with a brief description of various models being considered for use in effectiveness evaluation. (auth)

00079 (UCID—16808(Rev.1)) **Systems analysis of a security alarm system.** Schiff, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 May 1975. Contract W-7405-Eng-48. 34p. Dep. NTIS $4.00.

When the Lawrence Livermore Laboratory found that its security alarm system was causing more false alarms and maintenance costs than LLL felt was tolerable, a systems analysis was undertaken to determine what should be done about the situation. This report contains an analysis of security alarm systems in general and ends with a review of the existing Security Alarm Control Console (SACC) and recommendations for its improvement, growth and change. (auth)

00080 (Y-DJ—17186) **New emphasis on material accountability's role in special nuclear materials security.** Gambill, E.F. (Oak Ridge Y-12 Plant, Tenn. (USA)). Jun 1975. 5p. (CONF-750608—9). Dep. NTIS $4.00.

From Annual meeting of the institute of nuclear materials management; New Orleans, Louisiana, USA (18 Jun 1975).

An evaluation of the Y-12 Plant SNM accountability system determined that some changes could be made to upgrade SNM security. A system has been devised to supplement regular monthly enriched uranium inventories with verification inventories of selected batches. The revised system will also permit emergency inventories within six hours. The system changes are primarily in data handling and will cost very little. (auth)

00081 **Intrusion detector self-test system.** Schwarz, F. (to U.S. Energy Research and Development Administration). US Patent Application533,741. Filed date 17 Dec 1974. 16p.

An intrusion detection system is described, which automatically makes periodic tests of the operability of the system and provides an alarm in the event of a malfunction during the supervisory self-check regimen. This alarm is distinguishable from the normal intrusion alarm. (auth)

00082 **Importance of nuclear safeguards.** Ray, D.L. (Atomic Energy Commission, Washington, DC). pp vp of **Plutonium, safeguards, and the breeder.** New York; Atomic Industrial Forum, Inc. (1975).

From AIF public affairs workshop on plutonium, safeguards, and the breeder; Knoxville, Tennessee, USA (8 Oct 1974).

See CONF-7410119—.

The AEC chairman discusses questions dealing with the transportation of nuclear materials and with some of the broader aspects of safeguards. The nature and the tremendous expansion of the shipments and the applicable AEC regulations for their protection are described. Accountability and AEC's inspection strategy are covered, and the response of AEC and other government agencies in case of incident is described. Spending and activities of the AEC safeguards program are outlined; safeguards at government-owned facilities will be upgraded. R and D in the safeguards field is described. (DLC)

ADMINISTRATIVE AND REGULATORY

00083 **International safeguards.** Slawson, R.N. (Atomic Energy Commission, Washington, DC). pp vp of **Plutonium, safeguards, and the breeder.** New York; Atomic Industrial Forum, Inc. (1975).

From AIF public affairs workshop on plutonium, safeguards, and the breeder; Knoxville, Tennessee, USA (8 Oct 1974).

See CONF-7410119—.

Safeguards relating to the transfer of nuclear materials and equipment exported from the U. S. to other countries and international organizations are discussed. Procedures and regulations are described, and some current developments affecting the evolution of safeguards and controls are mentioned. IAEA agreements and the non-proliferation treaty are discussed. Special attention is being given to critical areas in the fuel cycle. The Sept. 23 statement of Secretary of State Kissinger before UN is quoted. (DLC)

00084 **Safeguards: regulatory requirements.** McWhinney, R.T. Jr. (Atomic Energy Commission, Washington, DC). pp vp of **Plutonium, safeguards, and the breeder.** New York; Atomic Industrial Forum, Inc. (1975).

From AIF public affairs workshop on plutonium, safeguards, and the breeder; Knoxville, Tennessee, USA (8 Oct 1974).

See CONF-7410119—.

The evolution of the AEC's safeguards regulations and its general philosophy and objectives are reviewed. The objectives are to protect against theft or diversion of nuclear materials, and against sabotage of nuclear power plants. Means for material protection at fixed sites and in transit, and for physical protection of power reactors and fuel cycle facilities are described. Actions underway are also discussed. (DLC)

00085 **Statement of Lester Rogers, Director of Regulatory Standards, U.S. Atomic Energy Commission, presented at EPA hearings on transuranium elements, December 10, 1974.** Rogers, L. (Atomic Energy Commission, Washington, DC). pp vp of **Plutonium, safeguards, and the breeder.** New York; Atomic Industrial Forum, Inc. (1975).

From AIF public affairs workshop on plutonium, safeguards, and the breeder; Knoxville, Tennessee, USA (8 Oct 1974).

See CONF-7410119—.

A summary is presented of some of the principal considerations given to limiting exposures to the public by the AEC as the Federal regulatory agency responsible for radiation protection standards in the nuclear industry. A bibliography of recent AEC regulatory issuances is included as Appendix A. Appendix B is also included which describes where Pu and other transuranium elements appear in the LWR fuel cycle, with and without Pu recycle, characterizes the transuranic plants, illustrates how the AEC regulatory process is being applied to these plants, and estimates the potential source terms. (DLC)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

00086 (UCRL—51833) **Discussions of bulk atomic or molecular separations by resonant radiation pressure.** Rinehart, E.A.; Richardson, J.H.; Hrubesh, L.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 May 1975. Contract W-7405-Eng-48. 16p. Dep. NTIS $4.00.

Resonant radiation pressure has been produced by the transfer of photon momentum to an atom or molecule during resonant absorption of photon energy. It is believed that this pressure is large enough to induce atomic and molecular separations when a laser is used as a source. A model was developed to describe the motion of molecules (or atoms) with a diffusion-limited mobility, under the influence of laser-induced resonant radiation pressure. The time dependency of the process was examined for a cw laser in the bulk movement of a one-component gas. Thermodynamic calculations showed that the process should be efficient and substantial. Preliminary experimental results were not conclusive. Two additional experimental techniques have been examined: the use of a pulsating laser source; and the use of periodic withdrawals and replenishings of the mixture within the system. Applications in the bulk separations of isotopic mixtures and optical isomers are discussed. (auth)

HEAVY WATER PRODUCTION

00087 **Tray performance evaluation.** Jones, D.W. (Du Pont de Nemours (E.I.) Co., Aiken, SC); Jones, J.B. Contract AT(07-2)-1. *Chem. Eng. Prog.*; 71: No. 6, 65-72(Jun 1975).

Gamma scanning and tray simulation have proven very useful and relatively inexpensive techniques for evaluating tray performance in the GS process for heavy water production. Broader use of these methods can be expected in the future. (auth)

RADIATION SOURCES

00088 (CONF-750723—1) **Intense 14 MeV neutron source using a spherical drive-in target.** Kim, J.; Morgan, O.B. (Oak Ridge National Lab., Tenn. (USA)). 11 Jul 1975. 13p. Dep. NTIS $4,00.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

A 14 MeV neutron radiation test facility using a drive-in spherical-shell target is discussed. This concept is based on a modest extrapolation of the present ion source technology and the drive-in target principle. Beams of equally mixed deuterons and tritons from ion sources are driven into a spherical target (diameter approximately 20 cm) from all directions. The inside of the spherical shell is accessible through two ducts for neutron irradiation samples, providing a large irradiation space with no significant variation in neutron flux densities. The expected neutron source intensity at the shell is S approximately 2×10^{12} n/cm² sec for a 300 keV—15 mA/cm², D-T mixed beam on a titanium target. The neutron flux obtained inside the shell increases monotonically with the radial distance from the minimum phi = S at r = 0 to, for instance, phi = 1.65 S at r = 0.9 a, where a is the radius of the spherical shell. This facility has a unique advantage in that a number of irradiation experiments can be performed simultaneously and a fairly uniform neutron flux can be obtained over an irradiation sample of large size. The target is designed to handle 4 to 5 kW/cm² of beam power by utilizing a "shell" of vortex-flow generators. D-T mixed gas is continuously recirculated and the target plating is done in-situ. Preliminary design ideas will be discussed. (auth)

00089 (DP-MS—75-34) **Californium-252: status and prospects.** Permar, P.H.; Karraker, D.G. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Sep 1975. Contract AT(07-2)-1. 12p. (CONF-750913—2). Dep. NTIS $4.00.

From 4. international transplutonium elements symposium; Baden-Baden, F.R. Germany (13 Sep 1975).

The development and present status of the practical applications of ^{252}Cf are reviewed. Future prospects for the applications in the period 1975 to 1980 are considered. (TFD)

00090 **Multi-layer monochromator.** Schoenborn, B.P.; Caspar, D.L.D. (to U.S. Energy Research and Development Administration). US Patent 3,885,153. 20 May 1975. Filed date 20 Jun 1974. 15p.

PAT-APPL-481,421.

This invention provides an artificial monochromator crystal for efficiently selecting a narrow band of neutron wavelengths from a neutron beam having a Maxwellian wavelength distribution, by providing on a substrate a plurality of germanium layers, and alternate periodic layers of a different metal having tailored thicknesses, shapes, and volumetric and neutron scattering densities. (auth)

00091 **Ion-beam mask for cancer patient therapy.** Castle, J.G. Jr. (to U.S. Energy Research and Development Administration). US Patent 3,886,367. 27 May 1975. Filed date 18 Jan 1974. 7p.

PAT-APPL-434,458.

An ion-beam mask has been provided for spatially distributing fast ions used to irradiate tumors so that the region near the Bragg peak receives a uniform radiation dose while the tissue at the point of entrance of the beam has a web of unirradiated volume to promote healing of the surface tissue following radiotherapeutic treatment of embedded tumors. (auth)

OTHER INDUSTRIAL USES

00092 (SAND—75-0436) **Waste resources utilization program. Progress report, period ending 30 June 1975.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Aug 1975. Contract AT(29-1)-789. 34p. Dep. NTIS $4.75.

Initial progress on the Waste Resources Utilization Program, a joint effort sponsored by ERDA and EPA under the terms of Interagency Agreement E(29-2)-3536/EPA-IAG-D5-0675 is reported. This program has as its objective the use of $^{134}Cs/^{137}Cs$ (a potential nuclear reactor "waste resource") as a gamma radiation source, coupled with modest heating, to treat sewage sludge (another "waste resource") to rid it of pathogenic organisms so that it may be safely used as a fertilizer or a feed supplement for ruminant animals. The potential exists for using at least 50 percent of the by-product cesium from future reactor fuel-rod reprocessing in this one application alone. Activities dealing with research on many aspects of the problem such as pathogen reduction, physical and chemical effects, cost benefit analysis, safety and security, and systems engineering are reported. (auth)

ISOTOPIC POWER SUPPLIES

00093 (BNWL—1845-11) **Pacific Northwest Laboratory monthly report to space nuclear systems division for May 1975.** Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1975. Contract AT(45-1)-1830. 8p. Dep. NTIS $4.00.

At Hanford, strontium will be separated from the high-level waste, then converted to the fluoride, and doubly encapsulated in small, high-integrity containers for subsequent long-term storage. The fluoride conversion, encapsulation and storage will take place in the Waste Encapsulation and Storage Facilities (WESF). This encapsulated strontium fluoride represents an economical source of ^{90}Sr if the WESF capsule can be licensed for heat source applications under anticipated use conditions. The objectives of this program are to obtain the data needed to license $^{90}SrF_2$ heat sources and specifically the WESF $^{90}SrF_2$ capsules. The information needed for licensing can be divided into three general areas: long-term SrF_2 compatibility data; chemical and physical property data on $^{90}SrF_2$; and capsule property data such as external corrosion resistance, crush strength, etc. The current program is designed to provide the required information. (auth)

00094 (MLM—2237) **Investigation of the problems associated with the Pt-20 Rh clads of the viking heat sources VF-3 and VF-7.** Zielinski, R.E. (Mound Lab., Miamisburg, Ohio (USA)). 25 Jul 1975. Contract AT-33-1-GEN-53. 102p. Dep. NTIS $5.45.

The investigation was undertaken to determine why the emissive coatings of the Viking Heat Sources VF-3 and VF-7 had flaked off the Pt-20 Rh clad material. During the course of the investigation, two additional, unusual phenomena were observed: a surface reaction zone on the uncoated Pt-20 Rh surfaces and grain boundary reactions in the weld zone of the clad. It seems that all three phenomena were the result of a complicated reaction couple that involved the heat source materials, storage container materials, and environment. Vapor transport mechanisms were responsible for the phenomena which were observed. The vapor transport mechanisms were probably initiated because of the impurities that were in both the heat source and storage container materials. The mechanisms resulted in significant changes in these heat sources because vapor transport was allowed to continue in a static environment for an unusually long period of time. (auth)

DESIGN AND FABRICATION

00095 (DPST—75-128-7) **^{238}Pu fuel form processes. Savannah River Laboratory monthly report, July 1975.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 25p. Dep. NTIS $4.00.

An empirical equation was developed to forecast neutron emission from fabricated fuel forms. Temperature, $^{16}O_2$ flow rate, and time are significant fabrication parameters. Increasing the shard heat-treatment temperature results in a rounding of shard surfaces and strengthening of the shard internal structure. Coarse shard-to-shard porosity is reduced as pressures are increased during hot pressing. The temperature threshold for helium bubble formation at grain boundaries of high-fired $^{238}PuO_2$ shards increases with decreasing grain size and increasing porosity. Hot-pressed $^{238}PuO_2$ pellets exhibited no deleterious microstructural changes due to helium release after storing for seven months followed by heating to 1600°C. Construction of the Plutonium Experimental Facility is underway. (auth)

00096 (GEPP—173) **Theoretical analysis of heat transfer in, and electrical performance of, a milliwatt radioisotopic powered thermoelectric generator.** Biver, C.J. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). 22 Jul 1975. Contract E(29-2)-656. 83p. Dep. NTIS $7.25.

A simplified, theoretical model has been made for a radioisotope-powered milliwatt thermoelectric generator (RTG). Calculations of unit heat transfer and electrical performance characteristics are made in two ways: (a) using discrete values of input physical parameters for an individual unit; and (b) using a statistical simulation (Monte Carlo) approach for estimating the variation in performance in a group of N-units. The statistical simulation approach is useful in: (a) estimating the allowable range of input parameters conducive to the production design meeting specifications in a group of N-units; and (b) determining particular parameters that must be significantly restricted in variation to achieve desired performance. The available experimental data, as compared with the discrete value calculations, are in quite good agreement (within 5 percent generally). (auth)

00097 (MLM—2226) **Summary of neutron measurements for the Viking Program.** Anderson, M.E. (Mound Lab., Miamisburg, Ohio (USA)). 15 Aug 1975. Contract E-33-1-GEN-53. 16p. Dep. NTIS $4.00.

The results of neutron measurements for ^{238}Pu-fueled, 683-W (thermal) capsules fabricated for the Viking Program (Mars Lander) are presented. These results include, for each capsule, the total neutron emission rate and neutron multiplication and, for one capsule, the neutron energy spectrum. A precision long counter was used for the neutron emission rate measurements and a single stilbene crystal for the neutron spectrum measurement. (auth)

00098 **Radioactive battery.** Deaton, R.L.; Silver, G.L. (to U.S. Energy Research and Development Administration). US Patent 3,884,718. 20 May 1975. Filed date 19 Apr 1973. 11p.

PAT-APPL-352,827.

A radioactive battery is described that is comprised of a container housing an electrolyte, two electrodes immersed in the electrolyte and insoluble radioactive material disposed adjacent one electrode. Insoluble radioactive material of different intensity of radioactivity may be disposed adjacent the second electrode. If hydrobromic acid is used as the electrolyte, Br_2 will be generated by the radioactivity and is reduced at the cathode: $Br_2 + 2e = 2\,Br^-$. At the anode Br^- is oxidized: $2Br^- = Br_2 + 2e$. (TFD)

HYDROGEN

PRODUCTION

THERMOCHEMICAL PROCESSES

00099 Method of producing hydrogen. Abraham, B.M.; Schreinner, F. (to U.S. Energy Research and Development Administration). US Patent Application536,694. Filed date 26 Dec 1974. 7p.

Water is thermochemically decomposed to produce hydrogen by the following sequence of reaction. KNO_3 and I_2 are reacted to produce KI, NO and O_2°, the NO and O_2 thus produced are reacted with water to form HNO_3°, a hydrogen-containing iodide—NH_4I or HI—is formed from the HNO_3°, and this iodide is thermally decomposed to produce hydrogen, all products of the reactions being recycled except hydrogen and oxygen. (auth)

STORAGE

CHEMISORPTION

00100 (BNL—17136) **Hydrogen storage and purification systems. Summary report, January 1971—June 1972.** Reilly, J.J.; Wiswall, R.H. Jr. (Brookhaven National Lab., Upton, N.Y. (USA)). 1 Aug 1972. 23p. Dep. NTIS $4.25.

Certain properties of metal-hydrogen systems relevant to their use for the storage and purification of hydrogen were investigated. Results are presented on equilibrium pressure-temperature-composition relationships for a number of metal alloy-hydrogen systems, and on the extent to which some of these systems can absorb hydrogen from gas mixtures containing CO_2, H_2O, and even CO. Specific conclusions of practical interest are, that reversible hydrides exist that can furnish hydrogen at one atmosphere at temperatures as low as -35°C; and that there are alloys which can form hydrides when exposed to a gas mixture of a composition like that resulting from the steam-reforming of a hydrocarbon followed by CO-shift and methanation steps. (auth)

PROPERTIES

00101 (DP-MS—75-16) **Role of test technique in evaluating hydrogen embrittlement mechanisms.** Louthan, M.R. Jr.; McNitt, R.P. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.; Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). 1975. Contract AT(07-2)-1. 11p. (CONF-750925—3). Dep. NTIS $4.00.

From Conference on effects of hydrogen on behavior of materials; Jackson, Wyoming, USA (7 Sep 1975).

Evaluation of the proposed embrittlement mechanisms indicates that the particular test techniques utilized have had major influences on the development of mechanistic proposals. The relationship between test techniques and proposed embrittlement mechanisms is discussed, and a group of observations with which any universal mechanism must be compatible is presented. (LK)

SOLAR ENERGY

RESOURCES AND AVAILABILITY

00102 Solar Energy systems: practical alternatives for the 1980's. Herwig, L.O. (Energy Research and Development Administration, Washington, DC). *Trans. Am. Nucl. Soc.*; 21: 144-145(Jun 1973).

From Transactions of the American Nuclear Society 1975 annual meeting; New Orleans, LA (8 Jun 1975).

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

00103 (SAND—75-5717) **Integrated photovoltaic-thermal solar energy conversion systems.** Samara, G.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 11p. (CONF-750725—1). Dep. NTIS $4.00.

From National solar photovoltaic program review meeting; Los Angeles, California, USA (22 Jul 1975).

Sandia's Solar Energy Systems Computer Analysis Code (SOLSYS) is being utilized to assess the technical and economic feasibility of combined photovoltaic systems relative to various utilization scenarios. Combined systems using concentrators and high efficiency (approximately greater than 10 percent) silicon cells can provide residences (or communities) with a reasonable balance of electrical and thermal energy. The device analysis code has been used to redesign the silicon cell for high temperature, high illumination operation. A design yielding 12 percent efficiency at 50 suns and 100°C has been selected. Modified cells have been fabricated and tested. Results have confirmed code predictions. A combined collector has been built and is being tested. Thermal efficiencies greater than 50 percent at 50 suns and 100°C can be expected. (auth)

00104 (SAND—75-5718) **Very low cost thin film CdS—Cu_2S solar cell development using chemical spraying.** Samara, G.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 24p. Dep. NTIS $4.25.

Over the past four years the D. H. Baldwin Company has developed a chemical spray process for the production of thin film CdS—Cu_2S solar cells projected to cost less than $60/kW in very large scale production. The average efficiency of these cells has been improved from less than 0.3 percent in 1971 to about 4.5 percent at present. The overall objectives of this program are to further develop the process, to raise the efficiency, and to attain long life stability. In the joint program Sandia Laboratories is to provide the technical support necessary to help achieve these objectives. (auth)

SOLAR THERMAL POWER PLANTS

00105 (PB—231115) **Solar thermal electric power systems. Annual progress report, 1 May—31 December 1973.** (Colorado State Univ., Fort Collins (USA)). Jan 1974. 288p. NTIS $6.75.

The objective of this research program is to develop design parameters for solar thermal electric power systems that can provide lowest cost electric power. Parametric performance and cost models are being developed for subsystems such as the concentrator, flat plate collector, absorber-heat transfer, heat transport, heat storage, heat engine, and cooling tower. Cost optimization methods are being developed, which can be used to select cost effective subsystem units, subsystem groups and to optimize the entire system. Power systems of 3 to 100 MW capacity that can be utilized in electrical networks are being considered. (NTIS)

00106 (PB—232670) **Solar thermal conversion mission analysis. Volume III. Southern California insolation climatology.** (Aerospace Corp., El Segundo, Calif. (USA)). 15 Jan 1974. Contract NSF-C797. 119p. (ATR—74(7417-5)-1(Vol.3)). NTIS $4.50.

An insolation data base consisting of hourly values of normal incidence (direct) insolation and total insolation for a two-year period has been prepared in computer-compatible format for eight stations characterizing Southern California and for Albuquerque, New Mexico. The data base includes, in addition to the insolation data, solar position information, and weather information. When measured insolation values are unavailable, estimated values, obtained by statistical procedures discussed in this report, are inserted so that the insolation data are complete. Some preliminary statistical studies have been performed on these data, including a comparison of insolation at various stations, a percentile frequency analysis of insolation values and a temperature insolation correlation analysis. In addition a literature survey of the information available about the distribution of sky brightness was made. The procedures used and the results of these various studies are discussed in detail in this report. (NTIS)

00107 (PB—232671) **Solar thermal conversion mission analysis. Volume IV. Mission/system and economic analysis.** (Aerospace Corp., El Segundo, Calif. (USA)). 15 Jan 1974. Contract NSF-C797. 158p. (ATR—74(7417-05)-1(Vol.4)). NTIS $5.00.

The report describes the mission/systems and economic analyses performed to examine the dynamic interaction of insolation, demand, and solar power systems. These analyses used the hourly demand projections and regional insolation data described in the previous volumes. A methodology was developed to parametrically assess the performance characteristics of alternative solar thermal conversion missions and systems in realistic operating environments on a consistent basis. When solar thermal conversion solar power plants are integrated with conventional nuclear and fossil power plants in a total power grid, a margin analysis must be performed to ensure that the integrated system provides equally reliable electric service. Having parametrically determined the

technical performance of solar power plants for different modes of operation, a comparative economic evaluation of these alternative power plant concepts and conventional power plants can be made. (NTIS)

00108 (PB—232679) **Solar thermal conversion mission analysis. Volume II. Demand analysis.** (Aerospace Corp., El Segundo, Calif. (USA)). 15 Jan 1974. 61p. (ATR—74(7417-05)-1(Vol.2)). NTIS $3.75.

The objectives of the analysis were to develop a methodology capable of characterizing future electric power demand data and to apply this methodology to forecast Southern California hourly electric power demand for the years 1980-2000. Forecasts of demand data exhibiting cyclic variations consistent with observed behavior patterns are necessary inputs to the solar thermal conversion system simulation. The approach used in meeting these objectives consists of several steps. Background information, technical reports, and raw data were acquired from governmental agencies and utilities throughout the country and particularly Southern California. A demand model was postulated to include factors describing a growth trend, weather conditions, seasonal influences, and hourly cyclic variations. A correlation between demand and weather, or insolation factors was investigated. A methodology was developed to decompose the time series representing the historic Southern California hourly electric power demand, and to recompose a future demand profile incorporating the historic cyclic variations with a projected trend and statistically varied weather influences. (NTIS)

00109 (PB—235475) **Solar thermal electric power systems. Quarterly progress report No. 1, 1 January—30 April 1974.** (Colorado State Dept. of Public Health, Denver (USA). Div. of Occupational and Radiological Health). Apr 1974. 177p. (NSF/RAN/SE/GI—37815/PR/74/1). NTIS $7.00.

Results of research to identify cost effective solar thermal electric power systems are given. Parametric performance and cost models were developed for concentrating collector, heat transport, and heat storage subsystems. Dynamic programming methods to select optimal subsystems and the solar thermal power systems are discussed. Power systems larger than 3 MW capacity that can be used in electrical networks are considered. (NTIS)

00110 (PB—236159) **Solar power system and component research program. Semiannual progress report No. 1, 15 January—15 July 1973.** Blake, F.A.; Walton, J.D. (Martin Marietta Aerospace, Denver, Colo. (USA)). 31 Jul 1974. 240p. (MCR—74-185; NSF/RANN/SE/GI—41305/PR/74/2). NTIS $7.50.

System analysis and component design for a 100-MWe solar energy conversion power system are discussed. Report covers user application analyses; meteorological analysis; economic analysis; boiler and superheater component research; and boiler design, bench model design, and test plan. (NTIS)

00111 (PB—238869(Vol.2)) **Solar thermal energy utilization. A bibliography with abstracts. Volume II. Cumulative volume.** (New Mexico Univ., Albuquerque (USA). Technology Application Center). Nov 1974. vp. NTIS $37.50.

Solar power generation is covered in this volume as follows: surveys and systems comparison, thermionic, thermoelectric, Rankine cycle, Brayton cycle, Stirling cycle, ocean thermal gradients, and others. (WDM)

OCEAN THERMAL GRADIENT POWER PLANTS

00112 (NP—20460) **Evaluation of the major and support fluid system necessary for the operation of a Rankine cycle ocean thermal difference machine.** Marshall, J.; Ambs, L. (Massachusetts Univ., Amherst (USA)). Nov 1974. 42p. NSF/RANN.

An idealized temperature versus entropy diagram for a closed Rankine cycle is shown along with a schematic of the cycle with major components. It is the purpose of this particular project to develop a concept of the fluid subsystems that will be essential for the safe and efficient operation of the OTDM. This study is concerned with the Mark II design presently being investigated at the University of Massachusetts under its OTDM project supported by the National Science Foundation. The conceptual design of the Mark II consists of a horizontal cylindrical hull with boilers mounted above the hull and condensers located inside the hull. Mark II is being designed for the Straits of Florida and will have a net power output of approximately 400 megawatts (MW). After consideration of many different working fluids two, propane and ammonia, were found to have the characteristics that are favorable for the OTDM. Propane was chosen in the Mark II design. (auth)

00113 (SAN—1089-T1-P1) **Ocean thermal energy conversion. Research on an engineering evaluation and test program. Volume 1. Executive summary. Final report.** (TRW Systems Group, Redondo Beach, Calif. (USA)). Jun 1975. Contract NSF-C958. 83p. Dep. NTIS $7.25.

Under contract to the Energy Research and Development Administration (ERDA), TRW Systems Group led a research team consisting of Global Marine Development Inc. (GMDI) and United Engineers and Constructors (UE and C) in performing "Research on an Engineering Evaluation and Test Program for Ocean Thermal Energy Conversion" (OTEC). The objectives of this study were to: Analyze and evaluate prior work; evaluate subsystems and components; synthesize a baseline system concept; and formulate a test program. These objectives have been achieved; their results are summarized in this volume. (auth)

00114 (SAN—1089-T1-P2) **Ocean thermal energy conversion. Research on an engineering evaluation and test program. Volume 2. Evaluation of prior work; subsystems and components. Final report.** (TRW Systems Group, Redondo Beach, Calif. (USA)). Jun 1975. Contract NSF-C958. 167p. Dep. NTIS $11.50.

TRW Systems Group and its two subcontractors, Global Marine Development Inc. of Los Angeles and United Engineers and Constructors of Philadelphia, have completed Research on an Engineering Evaluation and Test Program for Ocean Thermal Energy Conversion (OTEC). The goals and objectives of the study were to: (a) Analyze and evaluate prior work; (b) evaluate subsystems and components; (c) synthesize a baseline system concept; and (d) formulate a test program. This volume deals with activities in (a) and a portion of (b). (auth)

00115 (SAN—1089-T1-P3) **Ocean thermal energy conversion. Research on an engineering evaluation and test program. Volume 3. Baseline system concept. Final report.** (TRW Systems Group, Redondo Beach, Calif. (USA)). Jun 1975. Contract NSF-C958. 198p. Dep. NTIS $13.00.

TRW Systems Group, along with its two subcontractors, Global Marine Development Inc. of Los Angeles and United Engineers and Constructors of Philadelphia, has conducted research on an engineering evaluation and test program related to Ocean Thermal Energy Conversion. The goals and objectives of this study are to: (a) Analyze and evaluate prior work; (b) Evaluate subsystems and components; (c) Synthesize a baseline system concept; and (d) Formulate a test program. Activities (a) and a portion of (b) were completed and are reported in Volume 2. The remainder of (b) and essentially all of (c), except final component optimization and completion of engineering design details in a few areas, were completed by 31 January 1975 and are discussed in this volume. (auth)

00116 (SAN—1089-T1-P4) **Ocean thermal energy conversion. Research on an engineering evaluation and test program. Volume 4. Test program plan. Final report.** (TRW Systems Group, Redondo Beach, Calif. (USA)). Jun 1975. Contract NSF-C958. 47p. Dep. NTIS $5.50.

TRW Systems Group and its two subcontractors, Global Marine Development Inc. of Los Angeles and United Engineers and Constructors of Philadelphia, have conducted research on an engineering evaluation and test program related to Ocean Thermal Energy Conversion. The goals and objectives of this study were to: (a) Analyze and evaluate prior work; (b) Evaluate systems and components; (c) Synthesize a baseline system concept; and (d) Formulate a test program. Activity (d), formulation of a test program plan, is discussed in this volume. (auth)

00117 (SAN—1089-T1-P5) **Ocean thermal energy conversion. Research on an engineering evaluation and test program. Volume 5. Appendices. Final report.** (TRW Systems Group, Redondo Beach, Calif. (USA)). Jun 1975. Contract NSF-C958. 337p. Dep. NTIS $20.00.

Topics covered in this volume include: bibliography; power plant components and cost item listing; preliminary cycle analysis; review of heat transfer literature and concepts; turbine sizing; naval architecture and ocean operations; system specification for power station; comparison of hull configurations; thermal design of cold water pipe; mooring and positioning; heat exchanger analysis; and analysis and optimization model description. (WDM)

00118 (TID—26853) **Hot water hydraulics of the Gulf Stream sited OTGM.** Seluk, D.; Kirchhoff, R.H. (Massachusetts Univ., Amherst (USA)). Mar 1975. 75p. Dep. NTIS $6.75.

This report is the result of a study to determine if the kinetic energy of the Gulf Stream can be used as a pump for the evaporators in an OTES. The proposed evaporator is of the plate fin heat exchanger type, but calculations for the staggered tube type boiler have also been developed. The flow field for both types of evaporators is assumed to be similar to that of a screen submerged in an infinite two dimensional potential flowfield. The problem is then reduced to determining the pressure loss coeffi-

cient for each arrangement. Momentum and thermal recovery in the wake of ocean pumped plants is investigated, and graphs are presented to allow the determination of downstream plant spacing. (auth)

SOLAR RADIATION UTILIZATION

SPACE HEATING AND AIR CONDITIONING

00119 (CONF-750712—6) **Solar energy in providing for alternate lifestyles.** Martin, J.H. (Argonne National Lab., Ill. (USA)). 30 Jul 1975. 21p. Dep. NTIS $4.25.

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

Exploitation of cheap and abundant reservoirs of fossil fuels, we know, has permitted some cultures to develop a lifestyle and standard of living which depletes natural resources. To reduce the severity of this draw-down, a concept has been developed which combines the best of modern technology and the experience of more primitive societies in producing a residential option which is low in environmental impact as well as aesthetically attractive. An educational demonstration of this residential concept is to be developed on a six-acre plot twenty-five miles southwest of Chicago. This paper will identify the design and usage features which enable the occupants to collect all their residential energy from the Sun, to receive all their water from natural rainfall, and to recycle their wastes for return to a horticultural plot which will provide most of their food. This paper will also discuss the adaptability of this concept to a variety of situations through modifications or abbreviations. (auth)

00120 (COO—2577-4) **Design and construction of a residential solar heating and cooling system. Semi-annual progress report for January 1, 1974—July 31, 1974.** Loef, G.O.G.; Ward, D.S.; Ward, J.C.; Smith, C.C. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Aug 1974. 228p. (NSF/RANN/SE/GI—40457PR/74/2). Dep. NTIS $14.50.

The first integrated system providing heating and cooling to a building by use of solar energy has been designed and installed in a residential-type building at Colorado State University. Solar heated liquid supplies heat to air circulating in the building and to a lithium bromide absorption air conditioner. Service hot water is also provided. Approximately two-thirds of the heating and cooling loads are expected to be met by solar energy, the balance by natural gas. The report contains details of design and principles of operation. A breakdown of actual costs of the equipment and its installation is also provided. (auth)

00121 (COO—2577-8) **Liquid subsystems for collection, storage, and distribution of solar heat.** Smith, C.C.; Loef, G.O.G.; Ward, D.S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). 30 Jun 1975. 18p. (CONF-750351—1). Dep. NTIS $4.00.

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

The Solar Energy Applications Laboratory of Colorado State University has designed, constructed, and is presently operating a solar energy system for the heating, cooling, and service hot water heating of a residential style building. An aqueous solution of ethylene glycol is used as the solar collection fluid, with water used for the storage and load distribution medium. Many of the components and materials incorporated in this system, while having been employed in other applications, are new to the building heating and cooling field. The special considerations which must be confronted in the assembly of an optimized solar heating and cooling system are discussed in this report. Studies of the components required to efficiently transfer and store low temperature solar heat and to minimize loss of thermal availability are included. Several modes of operation permit critical comparisons of the subsystem components, materials, and engineering design. The performance of pumps, valves, and heat exchangers evaluated over a period of 8 months of operation, provides a basis for recommending specific designs, materials, and components as well as suggesting improvements in these areas. (auth)

00122 (COO—2606-T1) **Design and test report for transportable solar laboratory program.** (Honeywell, Inc., Minneapolis, Minn. (USA). Systems and Research Center). Oct 1974. 159p. Dep. NTIS $11.00.

A portable solar heating and cooling laboratory, designed and built by NSF and Honeywell, is described. The primary purpose of this laboratory is to provide a means to test the baseline design for a solar heating and cooling system under a variety of climates. By providing a calibration reference as well as a baseline, the laboratory also provides a means for evaluating and comparing both current and new solar heating and cooling designs. (WDM)

00123 (COO—2606-T2) **Transportable solar laboratory test results and utilization study for Albuquerque, N.M.** Holland, T.H. (Honeywell, Inc., Minneapolis, Minn. (USA). Systems and Research Center). Jan 1975. 20p. Dep. NTIS $4.00.

The purpose of the test facility is to provide information on solar energy collection which can be used for the evaluation of heating and cooling of domestic buildings in various climates. The first location for the TSL was Albuquerque, New Mexico, from August 10, 1974 to August 24, 1974. During this time the TSL was stationed at the Albuquerque Convention Center and at Sandia Laboratories. This report for Albuquerque presents collected solar energy data and total daily efficiency based on instantaneous collection values. A heating and cooling load analysis for a typical 1500 square foot Albuquerque house is given along with the portion of this load that can be provided by solar energy. The final part of this report will provide collector area and storage recommendations for the domestic use of solar collector systems in the Albuquerque area. (auth)

00124 (COO—2606-T3) **Transportable solar laboratory program test results and utilization study for Dallas, Texas .** Holland, T.H. (Honeywell, Inc., Minneapolis, Minn. (USA). Systems and Research Center). Apr 1975. 41p. Dep. NTIS $5.25.

The purpose of the Transportable Solar Laboratory is to provide information on solar energy collection whih can be used for evaluation of heating and cooling of domestic buildings in various climates. The second location for the TSL was Dallas, Texas, from August 24, 1974, to October 19, 1974. During this time, the TSL was stationed at the Greater Southwest Airport. This report for Dallas/Fort Worth presents collected solar energy data and total daily efficiency based on instantaneous collection values. A heating and cooling load analysis for a typical 1500 square foot Dallas house is given along with the portion of this load that can be provided by solar energy. The final part of this report provides an estimate of collector array area and storage tank size required for residential use of solar collector systems in the Dallas/Fort Worth area. (auth)

00125 (COO—2606-T4) **Transportable solar laboratory test results and utilization study for Miami, Florida.** Holland, T.H. (Honeywell, Inc., Minneapolis, Minn. (USA). Systems and Research Center). Apr 1975. Contract E(11-1)-2606. 50p. Dep. NTIS $5.50.

The purpose of the Transportable Solar Laboratory (TSL) is to provide information on solar energy collection which can be used for the evaluation of heating and cooling of domestic buildings in various climates. The third location for the TSL was Miami, Florida, from November 1, 1974 to December 6, 1974. During this time the TSL was stationed near the School of Engineering at the University of Miami, Coral Gables, Florida. This report for Miami presents collected solar energy data and total daily efficiency based on instantaneous collection values. A heating and cooling load analysis for a typical 1500-square-foot Miami house is given along with the portion of this load that can be provided by solar energy. The final part of this report provides an estimate of collector array area and storage tank size required for the residential use of solar collector systems in the Miami area. (auth)

00126 (N—74-25621) **Solar energy research and utilization.** Cherry, W.R. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). May 1974. 23p. (NASA-TM-X—70660; X—704-74-139). NTIS $4.25.

The role is described that solar energy will play in the heating and cooling of buildings, the production of renewable gaseous, liquid, and solid fuels, and the production of electric power over the next 45 years. Potential impacts on the various energy markets and estimated costs of such systems are discussed along with illustrations of some of the processes to accomplish the goals. The conclusions of the NSF/NASA Solar Energy Panel (1972) are given along with the estimated costs to accomplish the 15 year recommended program and also the recent and near future budget appropriations and recommendations are included. (auth)

00127 (SAND—75-0250) **Solar community systems analysis projects.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Jul 1975. Contract AT(29-1)-789. 50p. Dep. NTIS $5.50.

This report summarizes the solar total energy systems analysis projects funded by the National Science Foundation under grant number AG-564. The projects included development of an analysis computer program, the analysis of a 1000-home solar community, data acquisition, and load definition. (auth)

00128 (SAND—75-0250) **Solar community systems analysis projects.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Aug 1975. Contract AT(29-1)-789. 50p. Dep. NTIS $4.00.

This report summarizes the solar total energy systems analysis projects funded by the National Science Foundation under

grant number AG-564. The projects included development of an analysis computer program, the analysis of a 1000-home solar community, data acquisition, and load definition. (auth)

00129 (SAND—75-0278) **Solar total energy program semiannual report. Progress report, October 1974—March 1975.** Harrigan, R.W. (ed.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Jul 1975. Contract AT(29-1)-789. 80p. Dep. NTIS $5.45.

This report describes the activities of the Sandia Laboratories Solar Total Energy Program during the 6-month period, October 1974 through March 1975. Included are highlights of the period, descriptions of the system and its components, including recent modifications, and the results of systems analyses and component testing. (auth)

00130 (TID—26958) **Exploring space conditioning with variable membranes. Report for January 1, 1974—April 30, 1975.** Johnson, T.E.; Wellesley-Miller, S.; Chahroudi, D.; Brooks, J.; Wagner, S.; Heeschen, C.; Bryan, D. (Massachusetts Inst. of Tech., Cambridge (USA)). Apr 1975. 89p. Dep. NTIS $7.50.

Largely in response to unsatisfactory thermal conditions encountered in recent construction projects employing inflatable enclosures, a number of modified films and film composites have been suggested or manufactured in trial batches for such structures. These films and composite membranes offer variable transmittance and reflectivity as a means of controlling radiative and conductive heat loss and gain. This research project explores the application of the variable membrane concept to conventional frame supported buildings as well, using non-inflatable technologies to increase reliability, performance and acceptance. Under this approach solar radiation is passed directly into the interior through the building's large external surface area. The building skin is designed to continuously control the amount of short wave radiation entering, and the amount of long wave radiation leaving the interior. The solar energy heats the building interior masses which regulate the interior temperature and store surplus heat at comfortable controlled temperatures for night release. In effect, the entire building is a single solar collector. The same variable membrane can be used for cooling by reversing the radiation flow by passing more radiation to the outside than gets in. (auth)

00131 (UCID—3716) **Control system for combined solar heating and cooling systems.** Wahlig, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Pacific Gas and Electric Co., San Francisco, Calif. (USA)). 31 Jan 1975. 71p. Dep. NTIS $6.75.

An electronic control system is being developed that will be inexpensive in mass production, and yet will be capable of operating a solar heating and cooling system in an optimized or near-optimized manner. A generalized experimental solar heating and cooling system is being constructed for the purpose of testing and exercising the controller. Cooling will be provided, in the experimental system, by an ammonia—water absorption air conditioner, driven with solar-heated hot water. To provide data necessary for determination of economic feasibility of solar heating and cooling systems in central and northern California, a series of solar radiation measurement stations is being established for the accumulation of solar insolation data. (auth)

00132 (UCRL—77208) **Performance handbook for solar heating systems: a progress report.** Dickinson, W.C.; Neifert, R.D.; Loef, G.O.G.; Winn, C.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Colorado State Univ., Fort Collins (USA)). 12 Sep 1975. 42p. (CONF-750712—7). Dep. NTIS $5.25.

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

As the demand for solar heating increases and as commercial installations multiply, the need for a simpler and more versatile design procedure becomes critical. The cost of an hour-by-hour computer analysis of each building in every location is an unacceptable penalty in solar heating design. For these reasons, a design method based on the use of readily available long-term average local solar and weather data has been developed and compared with the more precise procedure requiring hourly data. The method is illustrated by its application to design in Albuquerque, New Mexico and Madison, Wisconsin. Plans are outlined to produce a set of tables usable by architects and engineers in sizing solar heating systems in 20 representative United States locations. An extrapolative method is also described to extend the use of these data to predict collector performance in other locations of the country, thus making the method generally useful. (WDM)

00133 **Total energy solar systems.** Stromberg, R.P. (Sandia Lab., Albuquerque, NM). *Trans. Am. Nucl. Soc.*; 21: 142(Jun 1973).

From Transactions of the American Nuclear Society 1975 annual meeting; New Orleans, LA (8 Jun 1975).

00134 **Technology assessment of solar heating and cooling of buildings.** Berkowitz, J.B. (A.D. Little, Inc., Cambridge, MA). pp 82-86 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

In July, 1974, under NSF sponsorship, Arthur D. Little, Inc., initiated a nine-month program to prepare a technology assessment of terrestrial solar energy resource development. Although the assessment covers the full range of solar applications currently under consideration, this paper briefly summarizes only those aspects of the assessment relating to the heating and cooling of buildings. (WDM)

00135 **Social, environmental, and institutional considerations: a report by Westinghouse Electric Corporation.** Weinstein, A. (Westinghouse Electric Corp., Baltimore, MD). pp 96-102 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

An assessment of the social and environmental acceptability of solar energy systems was conducted in specific problem areas, including: the social acceptability at the user level; the environmental acceptability; the impact on manufacturers; and the wide-scale application of solar heating and cooling of buildings through a building systems approach, using both architectural and engineering inputs. (WDM)

00136 **Environmental, social, and political aspects of solar heating and cooling of buildings: a report by TRW.** Jones, I.R. (TRW Systems, Redondo Beach, CA). pp 103-108 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

This report is a summary of the environmental, social, and political aspects of TRW's Solar Heating and Cooling of Buildings Phase O Study. Recommendations for Phases 1 and 2 of this program are also presented along with a brief discussion of utilization planning as well. (auth)

00137 **Acceptability and implementation of SHACOB systems: a report by General Electric Company.** Cohen, A.D. (General Electric Co., Valley Forge, PA). pp 109-116 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

This report treats three important topics—the social and environmental findings, the recommendations and plans for implementation of Proof-Of-Concept Experiments, and the longer range plans for widespread utilization of Solar Heating and Cooling of Buildings or SHACOB Systems. (auth)

00138 **Session IV advanced research and solar heating and cooling experiments.** Beattie, D.A. (National Science Foundation, Washington, DC). pp 127-132 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

The NSF advanced solar heating and cooling research program is briefly described and an evaluation of the contract awarding procedure is given. (WDM)

00139 **Solar house: Colorado State University.** Loef, G.O.G. (Colorado State Univ., Fort Collins). pp 133-141 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

Colorado State University received a grant from the NSF for the design, construction, and testing of a residential solar heating and cooling system. Progress on this grant is discussed in terms of the building design, system design, collector design, storage design, and cooling system design. (WDM)

00140 **Transportable solar laboratory.** Schmidt, R.N. pp 142-144 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

A brief description is given of the transportable solar laboratory and its operation is discussed. (WDM)

00141 **Phoenix Project.** Jardine, D.M. (Phoenix of Colorado Springs, Inc., Colorado Springs). pp 145-147 of **Solar heating and**

cooling of buildings. Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

The Phoenix Project in Colorado Springs is briefly described and the design and operation of the Phoenix house are discussed. System design parameters are given along with a brief sketch of the research program to be conducted. (WDM)

00142 Review of commercial possibilities for solar heating and cooling of buildings. Wilbur, D.E. Jr. (Arthur D. Little, Inc., Canmbridge, MA). pp 148-150 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

A brief discussion is presented on the commercial possibilities for solar heating and cooling of buildings. It is concluded that a favorable climate must be created for the construction industry through a national energy policy. (WDM)

00143 PROCEEDINGS OF THE WORKSHOP ON SOLAR HEATING AND COOLING OF BUILDINGS, WASHINGTON, D.C., JUNE 17—19, 1974. Iachetta, F.A. (ed.). Washington, DC; USA; National Science Foundation (1975). 164p. (NSF-RA-N—74-126; CONF-7406105—).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

This meeting was convened to make available to the public the findings of the NSF/RANN sponsored Phase 0 feasibility studies on solar heating and cooling of buildings and the results of a number of solar heating experiments. Separate abstracts were prepared for the papers presented. (WDM)

00144 Phase O feasibility and planning study: a report by General Electric Company. Cohen, A. (General Electric Co., Valley Forge, PA). pp 4-21 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

This paper presents a summary of General Electric's Solar Heating and Cooling of Buildings Program sponsored by the NSF. These comprehensive studies were initiated to provide baseline information for the widespread application of solar energy and to provide plans for follow-up programs. Seven key elements were addressed. Each of these was quantified, where possible, and studied in sufficient detail to draw generic comparisons and recommendations. Performance, operational, and functional, requirements were defined, and systems were synthesized and evaluated based upon these requirements. Potential and achievable markets for SHACOB (Solar Heating and Cooling of Buildings) were projected to the end of the century, considering cost effectiveness and energy-savings potential. Social and environmental aspects were examined, and recommendations for implementation were developed, starting with the Proof-of-Concept Experiments and culminating in widespread utilization. (WDM)

00145 Technical and economic considerations: a report by TRW. Jones, I.R. (TRW-Systems, Redondo Beach, CA). pp 22-30 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

Topics covered in this presentation include climatic regions, city selection, building types, heating and cooling load determinations, energy rate forecasts, reference system designs, capture potential assessment, economic performance market criteria—market penetration curves, optimum system definition, fuel availability, case assumptions, cost estimates, and market capture results. (WDM)

00146 Technical and economic considerations for solar heating and cooling of buildings: a report by Westinghouse Electric Corporation. Weinstein, A. (Westinghouse Electric Corp., Baltimore, MD). pp 31-44 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

The Phase O feasibility analysis involved ten specified tasks starting with a delineation of requirements and culminating with plans for utilizing the results. This discussion makes an attempt to outline the significant results presented in the main report. (WDM)

00147 Solar heating experiment: Timonium Elementary School, Timonium, Maryland. Barr, I.R. (AAI Corp., Baltimore, MD). pp 56-63 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

This presentation describes the solar heating system now successfully heating a portion of an elementary school in Timonium, Maryland. It is concluded that retrofitting schools for solar heating is not economically feasible in the 1975-1980 time frame in the Maryland/Washington area when compared with present costs of fossil fuels. It is further concluded that solar heating for new schools will be economically feasible if the system cost can be held to $10.00 per square foot. (WDM)

00148 Solar heating experiment: Grover Cleveland Junior High School, Boston, MA. Fowler, C.D. (General Electric Co., King of Prussia, PA). pp 64-68 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

The solar heating system for the Grover Cleveland Junior High School in Boston, Mass. is briefly described. The design and performance are discussed. (WDM)

00149 Solar heating experiment: North View Junior High School, Osseo, Minnesota. Kopecky, J.D. pp 69-73 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

A brief description is given of the solar heating system for the North View Junior High School, Osseo, Minn. The major components of the system (collector, heat exchangers, storage tank, weather station, and data-processing equipment) are discussed. The collector performance and system performance are briefly mentioned. (WDM)

00150 Solar heating experiment: Fauquier High School, Warrenton, Virginia. Beard, N.L.; Szego, G.C. (InterTechnology Corp., Warrenton, VA). pp 74-81 of **Solar heating and cooling of buildings.** Iachetta, F.A. (ed.). Washington, DC; National Science Foundation (1975).

From Workshop on solar heating and cooling of buildings; Washington, District of Columbia, USA (17 Jun 1974).

The solar heating system for the Fauquier High School, Warrenton, Virginia is described. The experimental and operational instrumentation is discussed. (WDM)

SOLAR COLLECTORS AND CONCENTRATORS

00151 (ANL-SOL—75-03) **Radiation transfer through specular passages. I. Diffuse incident radiation.** Rabl, A. (Argonne National Lab., Ill. (USA)). May 1975. 38p. Dep. NTIS $5.00.

A new technique is developed for calculating exchange factors for specular radiation passages of high reflectivity rho. It is shown that for a large class of configurations, even with curved reflector surfaces, the average number of reflections (n) can be calculated by a simple analytic formula and without any ray tracing. The exchange factor can then be approximated by rho/sup (n)/. The method is illustrated by many examples, including V-troughs and compound parabolic concentrators which are relevant for solar energy collection. The rho yields 1 limit of radiation cavities can be treated in a similar manner. (auth)

00152 (BNL—20313) **Preliminary concept analysis of a low cost non-metallic flat plate solar energy collector.** Cottingham, J.G. (Brookhaven National Lab., Upton, N.Y. (USA)). 21 Jul 1975. 15p. Dep. NTIS $4.00.

The concept of using non-metallic materials such as masonry, porcelain, or concrete as the thermal conducting media in the manufacture of flat plate solar energy collectors is examined and found functionally acceptable. The potential for large reduction in the cost of this component is illustrated. (auth)

00153 (CONF-750712—5) **Turning collectors: a compromise between stationary and heliostatic ones.** Barak, A.Z. (Argonne National Lab., Ill. (USA); Israel Desalination Engineering, Tel Aviv). 1975. 20p. Dep. NTIS $4.00.

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

A turning collector is defined as one which tracks the sun very crudely, stepwise, having 2 or 3 positions during the day. It is turned around an axis which is essentially parallel to the polar one. Its morning position is about 30° (10° to 50°) east of the longitude, its afternoon position is about the same angle west of the longitude, and its noon position for a three-position collector is ap-

proximately facing the equatorial direction. The turning operation may be effected manually or automatically—either by simple solar energized devices (such as a pair of Nitinol or bimetal elements), or by a more conventional mechanism. Turning collectors have qualitatively the same advantages and most of the disadvantages of tracking collectors, but quantitatively the major part of the advantages are obtained by the turning ones whereas only a relatively minor part of the disadvantages are involved. Thus, they seem to be economical for quite a few applications where concentrations of 10 to 40 are required or where relatively small collectors are necessary, supplying roughly 50 percent more energy per unit area than stationary collectors of the same concentration. (auth)

00154 (LA-UR—75-1335) **Research on integrated solar collector roof structures.** Balcomb, J.D.; Hedstrom, J.C.; Moore, S.W.; Herr, K.C. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 12p. (CONF-750712—4). Dep. NTIS $4.00.

From Annual meeting of the International Solar Energy Society; Los Angeles, California, USA (28 Jul 1975).

Several prototype models for an integrated solar collector-roof structure member are described and operating data are given. Fabrication and costs are briefly discussed. The prototypes include both liquid and air cooled models. (WDM)

00155 (SLL—74-5209) **Temperature of cavity-type solar absorbers with a circulating fluid.** Abrams, M. (Sandia Labs., Livermore, Calif. (USA)). 1974. vp. NTIS.

An analytical expression is obtained for the temperature of a cavity-type absorber of solar radiation which has a circulating heat transfer fluid. This expression relates effective cavity temperature to the temperature of the incoming fluid, cavity geometry, emissivity, coolant flow rate, and the incident radiative flux. (auth)

00156 EVALUATION OF SURFACE GEOMETRY MODIFICATION TO IMPROVE THE DIRECTIONAL SELECTIVITY OF SOLAR ENERGY COLLECTORS. Howell, J.R.; Bannerot, R.B. Washington, DC; USA; National Science Foundation (1974). 10p.

The performance of the flat-plate collector can be greatly enhanced with the use of spectrally (wavelength) and/or directionally selective surfaces. Examined are two model geometries to determine the optimum parameters that will maximize the directional selectivity. The choice of the models is based on a trade-off study considering cost and predicted performance. The two models will be constructed and tested for their actual radiative behavior. This behavior will then be compared with the predicted values. The radiative properties necessary to the analysis will be determined experimentally. (auth)

GEOTHERMAL ENERGY

RESOURCES AND AVAILABILITY

00157 (CONF-740209—) **Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.** Colp, J.L.; Furumoto, A.S. (eds.). (Sandia Labs., Albuquerque, N.Mex. (USA)). 1974. 680p. Dep. NTIS $37.00.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Thirty-two papers are included. A separate abstract is prepared for each paper. (LBS)

NON-USA

00158 (CONF-740209—, pp 75-79) **Estimation of potentials for the Hatchobaru geothermal area, Northern Kyushu, Japan.** Onodera, S. (Kyushu Univ., Japan). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

To find a simple estimation on the potential for a geothermal field, several graphs were prepared on the Otake and Hatchobaru well data, together with heat flow, water table, temperature gradient, shut-in pressure, etc. The graph shows a linear relation between the steam flow rates and the corresponding output in KW or ejection velocity of steam. An estimation based on actual data yields 156,000 KW for the entire potential for the Hatchobaru geothermal area. (LBS)

SITE GEOLOGY, HYDROLOGY, AND METEOROLOGY

00159 (CONF-740209—, pp 251-272) **Influence of mechanical stressing on heat flow.** Rinehart, J.S. (Hyper Dynamics, Santa Fe, NM). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The effect of mechanical stresses on the rate at which energy can be extracted from a volcanic area is discussed. Three principle ways by which nature applies varying mechanical forces are: loading by the air mass resting on the surface; variations in gravity caused by earth tidal forces, and tectonic stresses, frequently associated with earthquake activity. These forces are discussed in relation to variations in geyser activity. (LBS)

USA

00160 (CONF-740209—, pp 225) **Anomalous microseisms in Surprise Valley, California.** Eng, K.; Decker, R.W. (Dartmouth Coll., Hanover, NH). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

During 1973 three areas of apparent geothermal noise were located in Surprise Valley, California. These areas have characteristic 2 to 3 Hz microseisms with velocity amplitudes up to 10 times the background microseisms. All three areas are on alluvium or lake sediments. In 1973 the Fort Bidwell anomaly was investigated with arrays of seismometers and explosions. Most of the microseismic anomaly can be explained by ground amplification, but this does not explain the bursts of coherent vibrations at some array locations. The possibility of a diffuse source of vibrations from the subsurface is not ruled out. (LBS)

00161 (CONF-740209—, pp 229-236) **Behavior of Kilauea Volcano and its bearing on possible utilization of volcanic energy.** Peterson, D.W. (U.S. Geological Survey, Hawaii). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

Some of the studies by the Hawaiian Volcano Observatory of the behavior of Kilauea volcano and some significant problems that will be associated with locating and utilizing suitable geothermal regions are reviewed. (LBS)

00162 (LA—6017-MS) **Hydrologic testing Geothermal Test Hole No. 2.** West, F.G.; Kintzinger, P.R.; Purtymun, W.D. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. Contract W-7405-ENG-36. 8p. Dep. NTIS $4.00.

Analyses of drill-stem tests performed in Geothermal Test Hole No. 2 (GT-2) indicate that the jointed, but competent, rock tested can for geothermal project purposes be considered "dry." The intervals tested were selected by the use of geophysical logs so as to exclude occasional zones of intense fracturing. (auth)

00163 (UCLA—34P224X1) **Relationship of rock physics and petrology to geothermal energy technology. Progress report, November 1, 1974—August 1, 1975.** Warren, N.; Grew, P.P.; Trice, R.E. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics). 1975. 26p. Dep. NTIS $4.50.

The following progress made during the period November 1974 through August 1975 is reported. Detailed petrographic characterizations have been made of drill core samples from LASL geothermal test holes. Correlations between rock texture and bulk elastic properties have been studied. Theory of texture effects on elastic moduli has been extended, and a rock-modeling code has been further developed and tested. A theoretical study of possible applications of stress corrosion cracking to geothermal technology was made. (LBS)

NON-USA

00164 (CONF-740209—, pp 13-39) **Hydrothermal system and seismic activity of Hakone volcano.** Oki, Y.; Hirano, T. (Hot Spring Research Inst. of Kanagawa Prefecture, Yumoto 997, Hakone, Kanagawa, JA). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The structure of the Hakone hydrothermal system and geochemistry of thermal waters are described. The subsurface temperature map and the zonal distribution of thermal waters strongly suggest that thermal energy of the Hakone system is essentially supplied by dense volcanic steam rich in sodium chloride coming up through the volcanic conduit, from which subsurface streams of sodium chloride waters are derived. The seismic activity of Hakone mostly takes place at relatively shallow depths in the central part of the caldera. The chemical and physical properties of the dense steam are examined assuming that the phase transformation of water to steam is the major cause for volcanic earthquakes. The Cl-SO_4 chemistry permits estimation of sodium chloride content of 0.5 to 1 percent in original dense steam responsible for sodium chloride waters. Temperature pressure condition of volcanic dense steam at depths of 1 to 2 km below sea-level is estimated to be about 385°C and 230 bars, dissolving 0.5 to 1 percent of sodium chloride in steam. Below the depth of 4 km, earthquakes seldom occur, the hydrothermal system is saturated with solid sodium chloride, resulting in lowered vapor pressure. This implies that the permeation of meteoric water to the volcanic steam system mostly takes place at a depth less than 4 km. The analogy of hot eyes (centers of geothermal fields) and cold eyelids (surroundings of low temperature area) is emphasized for better understanding of hydrothermal systems. (auth)

00165 (CONF-740209—, pp 59-73) **Geophysical evidence for the availability of geothermal energy in New Britain.** Wiebenga, W.A. (Bureau of Mineral Resources, Canberra, Australia); Furumoto, A.S. 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

Some of the results and interpretations of geological mapping, seismic refraction, marine seismic, and gravity surveys are combined to show that large tracts of New Britain could be favorable targets for geothermal power development. It is shown that the fractured and faulted lithosphere is associated with grabens and rifts in which mantle material has risen to within 10 to 15 km from the surface. The grabens and rifts are marked by volcanism in which the dominant volcanic rocks are olivine—and tholeiitic—basalts, with a sprinkling of more acid volcanics ranging from dacite to andesite. The two areas selected as favorable for future geothermal power development are located between Talasea and Lolobau Is., say around Hoskins; and near Rabaul, between Matupi Harbour and Matupi. (auth)

00166 (CONF-740209—, pp 169-189) **Potential utilization of heat energy from Philippine volcanic areas.** Alcaraz, A. (Commission on Volcanology, Quezon City, Philippines). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The generation of power from indigenous sources to meet the needs of industrial growth and dispersal has been made an integral part of the long-term strategy for economic development of the Philippines. This calls for geothermal energy resources to supply about a fourth of the country's power generation. Fortunately, the Philippines apparently is endowed with ample potentials of this energy resource. A review of the geologic setting of the Archipelago is given. The geothermal implications of the structural and lithologic development of the Archipelago are analyzed. The more salient implications are: That Philippine geology offers favorable locale for a sizeable geothermal resource; that the reservoir rocks in general will consist of altered and/or porous volcanic units capped by lava flows or relatively impermeable clastic sedimentary layers and piedmont deposits; that arcuate faulting, and in some cases, wrench faulting will delineate the reservoirs; that the productive horizons will probably lie between 3,500-5,000 feet; and that most of the geothermal fields will be hot-water systems, that is, the wells will discharge a mixture of hot-water and steam. (LBS)

00167 (CONF-740209—, pp 191-204) **Physical nature of source parameters of volcanic earthquakes.** Minakami, T. (Univ. of Tokyo). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The pattern of hypocentral distribution of earthquakes originating in and around several calderas is reviewed. In particular, the 1959-1960 and 1966 earthquake swarms in the Hakone caldera; the 1968-1969 Kakuto caldera quakes, Kirisimi volcano, the 1970-1972 activity of Pozzuoli in Flegraean Field (caldera), and seismic activity in and around Kilauea caldera are discussed. (LBS)

00168 (CONF-740209—, pp 205-223) **Alaskan volcano studies, with special reference to Augustine volcano.** Kienle, J. (Univ. of Alaska, Fairbanks). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The 60 recent volcanoes in Alaska constitute a substantial energy resource if utilization of volcano energy should become a reality in the future. The remoteness of most Alaskan volcanic centers poses a challenge to developing their potential energy resources and explains the fact that volcanological studies in Alaska are in their infancy. The University of Alaska has in the last years begun to investigate a few selected volcanoes, including Wrangell-, Redoubt-, Augustine-, Pavlov- and the Katmai volcanoes. Amongst these, Augustine was studied in greatest detail. Since the last major eruption in 1883 it has developed three new central lava domes. Shallow microearthquake swarm activity is triggered by both, maximum earth tidal acceleration (equivalent to volume dilatation) and maximum ocean tidal loading. (auth)

00169 (CONF-740209—, pp 643-649) **Characteristic geotectonic environments of some geothermal fields related with quaternary volcanic zones.** Yamasaki, T. (Kyushu Univ., Japan). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The rising-fissuring-volcanism relation proposed by Cloos (1939) is shown by a well-known block diagram. Some of depressions—grabens, fault troughs or rift zones typically occur along the crests of upwarps and often closely associate with vulcanicity. Recent work suggest that these depressions may originate in various ways from the viewpoints of modern geotectonics or mechanism of magmatic intrusions etc. and their causes are generally not so simple as Cloos's. Nevertheless, there are many geothermal fields of the world, especially in and along the Cenozoic Circum Pacific Orogenic and Volcanic Zone, characterized by such depression zones associated with mostly of Quaternary volcanic activities, some of which are still active. The association of vulcanicity with depressions in these geothermal fields may thus be shown as remarkable similarities with the Cloos's diagram, except for the detailed and various origins forming the regional structures. This is illustrated by the Otake and Wairake: geothermal fields. (auth)

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

00170 (UCRL-Trans—10895) **Hydrothermal systems associated with volcanism and the prospecting thereof for economic purposes. Application to the Furnas region (S. Miguel, Azores).** Quintino, J. Translated from *Tecnica (Lisbon)*; No. 389, 449-472(1969). 54p. Dep. NTIS $5.75.

In regions of volcanic origin, surface heat flow may attain values 500 times higher than normal. Economic exploitation by means of wells drilled to tap high-temperature steam has been possible, especially when water and steam are stored in strata of fractured rock. The potential yield of a geothermal field can be evaluated by means of geological and geophysical prospecting; a geochemical study of the surface expressions of volcanism—fumaroles, geysers and thermal springs—is of major importance in the determination of the characteristics of the underground hydrothermal system. The Furnas region on S. Miguel Island appears to be the most suitable due to the spectacular activity of secondary volcanism. A work program has been proposed on the basis of the experience acquired in other volcanic regions—New Zealand, California, Italy and Iceland. A well-founded idea regarding the prospects of developing the geothermal energy of the Furnas region and of the Azores generally will only be possible upon completion of the work. (auth)

GEOPHYSICAL TECHNIQUES AND SURVEYS

00171 (CONF-740209—, pp 10-12) **Imagery from infrared scanning of the east and southwest rift zones of Kilauea and the lower portion of the southwest rift zone of Mauna Loa, Island of Hawaii.** Abbott, A.T. (Univ. of Hawaii, Manoa, HI). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

From July 31 through August 4, 1973 night time flights for obtaining infrared imagery along the east and southwest rift zones of Kilauea and the southwest rift zone of Mauna Loa were undertaken on the island of Hawaii. A surface thermal anomaly was registered along the flight path of the Kilauea rift zone with the temperature range of 18° to 22°C. The temperature range along the flight path of the Mauna Loa rift zone was 16° to 22°C. It is suggested that these zones might be potential areas for further geophysical investigation and possibly research drilling. (LBS)

00172 (CONF-740209—, pp 41-58) **Geophysical exploration on the structure of volcanoes: two case histories.** Furumoto, A.S. (Univ. of Hawaii, Honolulu). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

Geophysical methods of exploration were used to determine the internal structure of Koolau Volcano in Hawaii and of Rabaul Volcano in New Guinea. By use of gravity and seismic data the central vent or plug of Koolau Volcano was outlined. Magnetic data seem to indicate that the central plug is still above the Curie Point. If so, the amount of heat energy available is tremendous. As for Rabaul Volcano, it is located in a region characterized by numerous block faulting. The volcano is only a part of a large block that has subsided. Possible geothermal areas exist near the volcano but better potential areas may exist away from the volcano. (auth)

00173 (CONF-740209—, pp 80-106) **Geo-electrical indications at the Otake geothermal field in the western part of the Kujyu Volcano Group, Kyushu, Japan.** Onodera, S. (Kyushu Univ., Japan). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

Self-potential and resistivity measurements were carried out at production wells of the Otake geothermal field including the Hatchobaru areas. The results are shown graphically. The self-potential measurements indicated three potential zones, namely Otake, Hizenyu-Sujiyu-Komatsuike, and Hatchobaru potential zones. In the Hatchobaru potential zone, the existence of the negative center of -100 mV resulted in the discovery of a new geothermal area, where a 50 MW power plant will be completed at the end of 1975. Resistivity measurements are also described. The results were useful in determining the subsurface structure in the western part of the Kujyu volcano group. (LBS)

00174 (CONF-740209—, pp 154-159) **Seismic noise surveys in geothermal areas.** Iyer, H.M. (U.S. Geological Survey, Menlo Park, CA). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

Seismic noise measurements were made in Imperial Valley and Long Valley, California, and Yellowstone National Park, Wyoming, to evaluate whether seismic noise can be used as a prospecting tool in geothermal exploration. It is concluded from these experiments that seismic noise in the frequency range of 2 to 8 Hz seems to exist in geothermal areas and is probably generated at depth by convection systems. (LBS)

00175 (CONF-740209—, pp 160-167) **Use of microearthquakes in prospecting for geothermal areas and magma chambers.** Ward, P.L. (U.S. Geological Survey, Menlo Park, CA); Koyanagi, R. 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

It is pointed out that studies of microearthquakes in major geothermal areas seem useful for studying the subsurface structure of these areas and for locating regions of convective heat transfer. (LBS)

00176 (CONF-740209—, pp 603-616) **Geothermal power generations in Basaltic Provinces, Lanzarote (Canary Islands).** Arana, V.; Ortiz, R.; Badiola, E.R.; Yuguero, J. (Univ. of Madrid). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

Preliminary results of geochemical and geophysical surveys in Lanzarote are reported. The data suggests empirical relation between a possible geothermal reservoir with the high temperatures and thermal gradient, negative gravity, low resistivity, high ground noise, and isotopic anomalies. (LBS)

00177 (LA—6022-MS) **Temperature measurements in the Precambrian section of Geothermal Test Hole No. 2.** Albright, J.N. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. Contract W-7405-ENG-36. 11p. Dep. NTIS $4.00.

Temperature measurements have been made throughout most of the Precambrian section of Geothermal Test Hole No. 2 (GT-2), the second deep exploratory test hole in the Los Alamos Scientific Laboratory's Dry Hot Rock Geothermal Energy Project. Successful bottomhole temperature measurements were made at nine successive depths during interruptions in drilling. A thermistor probe was used to measure temperature under conditions in which the bottom 10 m of the borehole was filled with either air, water, mud, or water-saturated silt. Several techniques were developed to insure that the thermistor sonde was positioned directly on bottom and isolated from the convecting borehole fluids. These techniques proved successful. Equilibrium rock temperatures calculated from relaxation data using a new method show geothermal gradients of from 50 to 60°C/km in the intervals measured, the gradient generally increasing with depth. The equilibrium rock temperature is 195.8°C at a depth of 2900 m (28 m above the present bottom of the borehole) based on the 30 h of continuous bottomhole temperature measurements. The extrapolated equilibrium rock temperature at the GT-2 terminal depth of 2928 m is 197°C. (auth)

REGULATIONS

00178 (CONF-740209—, pp 107-111) **Research drill hole at the summit of Kilauea Volcano, Hawaii.** Keller, G.V. (Colorado School of Mines, Golden, CO). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

An exploration hole has been drilled to a depth of 1262 m beneath the summit of Kilauea Volcano on the Island of Hawaii in order to obtain information about the potential for the occurrence of geothermal energy in a basalt environment. The hole was started at an elevation of 1102 m, and bottomed at an elevation of -160 m. Short intervals were cored, but the principal information obtained from the hole was in the form of physical measurements. The temperature profile through the hole was complicated, showing several reversals and reached a maximum value of 137°C at the bottom. Geophysical logs indicate that rocks are fully water saturated to an elevation of about 500 m above sea level, and that the water in the rock has a salinity about equal to or slightly greater than that of sea water. This result supports the pre-drilling hypothesis that there should be a convection cell formed of warm saline water above a shallow magma chamber at Kilauea Volcano. (auth)

00179 (CONF-740209—, pp 617-632) **Penultimate geothermal system in legal perspective.** Sheets, G.M. (Univ. of Hawaii, Honolulu). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The operations necessarily a part of conversion processes for the purpose of making hotter phases of magmatic energy resources available to alleviate energy-shortage problems poses many problems generally classified as legal. Of particular interest are the legal implications; and, superficially, the potential physical systems which are called "penultimate geothermal systems"; one stage removed from "direct" conversion without intervening mechanical means. It is postulated that the search for geothermal energy will proceed offshore, and quite likely from an island setting such as the Hawaiian chain. Questions of domestic as well as international law are considered in context dictated by the nature of the available magmatic energy resources and the nature of operations necessary to achieve their availability as storable and transportable energy forms for use in ordinary course of commerce. Assumptions are made that advances in the state of art in geophysics, drilling techniques, materials technology, and other pertinent technological specialties will continue to improve the likelihood of acquiring access to these energy resources at about the same rate as recent experience has shown we can reasonably expect. Thus, the challenge is to create access to the heat of the mantle found in sea-bottom crustal formations, and a legal system to facilitate operational activities to the purpose. (auth)

ECONOMICS

00180 (UCRL—77031) **Economics of geothermal heat as an alternate fuel** . Towse, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1975. 22p. (CONF-750946—1). Dep. NTIS $4.25.

From Meeting of the Society of Mining Engineers; Salt Lake City, Utah, USA (12 Sep 1975).

Projections of energy needs in several United States economic sectors and the technical possibility of geothermal heat substituting for other fuels in those sectors are first considered. Then, reported and projected costs of energy from geothermal heat are compared with costs of other fuels to show the relative costs in several economic sectors. Relative costs are reported from a sample of real and hypothetical geothermal projects. Capital requirements and time required to meet development objectives particularly for electric production are next examined. (LBS)

BY-PRODUCTS

00181 (ANCR—1220) **Fish culture utilization of geothermal energy.** Roberts, P.A. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jun 1975. Contract E(10-1)-1375. 55p. Dep. NTIS $5.45.

Geothermal water and energy are suitable resources for fish farmers to use to raise large quantities of high-protein fish. Water quality and the domestication of new species of fish are areas where considerable research is indicated. This report indicates how geothermal resources could be utilzed to supply the various environmental requirements for fish. (auth)

GEOTHERMAL POWER PLANTS

POWER CONVERSION SYSTEMS

00182 (ANCR—1224) **Review and tentative selection of a working fluid for use with a medium temperature (300°F) geothermal resource.** Whitbeck, J.F. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Jul 1975. Contract E(10-1)-1375. 19p. Dep. NTIS $4.00.

A review of conventional refrigerants was made to determine the best fluid to be used as the working fluid in an electrical power plant application where energy will be derived from a medium temperature geothermal heat source. Major considerations were operating pressures, operational flexibility, thermal efficiency, line sizes and potential for best utilization of the geothermal heat source. As a result of this work, isobutane was selected as the best working fluid for a 300°F geothermal fluid application. This fluid has been identified by other investigators for use with higher temperature application. Its acceptability for the lower temperatures indicated the general utility of this fluid for power plant applications over a significant temperature range. In an effort to obtain maximum utilization of the geothermal fluid, a dual boiling cycle was selected as the reference cycle for preliminary study and a basis for future comparative analysis. (auth)

00183 (CONF-740209—, pp 431-508) **Total flow concept for recovery of energy from geothermal hot brine deposits.** Higgins, G.H. (Lawrence Livermore Lab., CA). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

A new method is described for producing electrical power from the energy stored in hot brine deposits. The proposed method is developed specifically for application to the brines of the Salton Sea geothermal area, where enough energy is stored to provide at least 100,000 MW electrical generation capacity for more than 20 yr. Once developed, the proposed method, then, will certainly be applicable to other geothermal deposits. The method uses the total flow concept. Hot brine is allowed to expand (from 300°C, 2200 psia, at approximately 5000 ft) to the surface where the wellhead product contains approximately 20 percent vapor by weight and approximately 560 Btu/lb at approximately 400 psia. This thermal energy is converted to kinetic energy by expansion of the mixture through a converging-diverging nozzle. The high velocity output is used to drive a modified hydraulic impulse turbine operating at approximately 3.5 in. Hg (120°F). Theoretically, this method should produce 60 percent more power than other systems, either operational or proposed, for the hot brine application. It is estimated that an electrical power generation station using this concept will require a capital investment of approximately 200 dollars/kW and should produce power at a cost of approximately 3 mills/kWh. For a power sales price of 8 mills/kWh, the internal rate of return is estimated to be between 10 percent and 20 percent, depending on the method of taxation and royalty charges. (auth)

GEOTHERMAL ENGINEERING

DRILLING TECHNIQUES AND WELL HARDWARE

00184 **New drill bits hold geothermal promise.** *Geotherm. Energy Mag.;* 3: No. 6, 5-7(Jun 1975).

Sandia Laboratories is developing four new drill bits designed to speed the cutting of drill holes, thus reducing the costs of tapping underground mineral and energy resources. Two of the drills—one which chips rock with high voltage spark discharges, and another which fires small projectiles into the rock in advance of a regular roller bit—are designed to increase both penetration rates and downhole bit life. The other two systems aim at increasing bit life. One of these systems permits a roller-cone bit to be folded and removed while another bit is cycled into place from a magazine containing 10 to 12 new bits. The other system has its cutting surface on a chain which is advanced to bring new cutting surfaces into position. (LBS)

00185 **Advanced drilling technology.** Narath, A. (Sandia Labs., Albuquerque, NM). *Geotherm. Energy Mag.;* 3: No. 6, 8-17(Jun 1975).

The drilling research and development program at Sandia Laboratories is described. Two techniques under investigation for mapping hydraulically induced fractures in rock formations around natural gas wells are discussed. Some results on the development of improved drilling bits are given. (LBS)

00186 **Subterrene program.** Contract W-7405-eng-36. *Geotherm. Energy Mag.;* 3: No. 7, 31-35(Jul 1975).

Potential applications of subterrene penetrators in LASL's energy development program are briefly discussed. The subterrene design and test status are also described. (LBS)

ARTIFICIAL STIMULATION

00187 (CONF-740209—, pp 415-429) **Artificial geothermal reservoirs in hot volcanic rock.** Aamodt, R.L. (Univ. of California, Los Alamos, NM). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The Los Alamos Scientific Laboratory is conducting an experiment about 4 kilometers west and south of the ring fault of the Jemez Caldera in the north central part of New Mexico. The experiment is designed to demonstrate that geothermal energy may be extracted from hot rock which does not contain circulating hot water or steam, and which is relative impermeable. Th creation of an artificial geothermal reservoir by hydraulic fracturing is described, and some results on the measurement of earth stress in an exploratory hole are discussed. (LBS)

00188 (CONF-740209—, pp 587-594) **Problems waiting solution to utilize volcanic heat.** Hayashida, T. (Nagasaki Univ.). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

A list of necessary information and studies to be carried out to promote planning, engineering, and economic evaluation of a volcanic power plant in an artificially fractured zone is presented. (LBS)

00189 **Geothermal energy: hot dry rock technology.** Smith, M.C. (Los Alamos Scientific Lab., NM). *Trans. Am. Nucl. Soc.;* 21: 142(Jun 1973).

From Transactions of the American Nuclear Society 1975 annual meeting; New Orleans, LA (8 Jun 1975).

ENERGY UTILIZATION

00190 (ANCR—1241) **Geothermal space heating of a geothermal drilling rig.** Keller, J.G.; Miller, L.G.; Mines, G.L.; Richardson, A.S. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Jun 1975. Contract E(10-1)-1375. 24p. Dep. NTIS $4.00.

A geothermal space heating demonstration unit to establish the viability of geothermal water is described in this report. Heating of a drilling rig by geothermal hot water from a nearby artesian

well has greatly reduced heating costs. The results of this report conclude that the saving of fossil fuels are approximately equivalent to that required to heat 80 average homes in Southern Idaho. (auth)

00191 Carrying out heat-promotable chemical reactions in sodium chloride formation cavern. Jacoby, C.H. (to International Salt Co.). US Patent 3,858,397. 7 Jan 1975. Filed date 19 Mar 1970. 16p.

Chemical reactions, requiring heat are effected without air pollution contributions at reaction sites in underground cavities which are uniquely located to take advantage of little known and rarely occurring subterranean heat supply and heat conducting characteristics of certain geological structures extending in thermal continuity with heat sources far below reach of modern bore hole drilling techniques. Reactants are fed to the cavity and products are removed therefrom by means of passageways through bore holes extending from the earth's surface into the cavities. The activities are located at such depths, in highly heat conductive mineral spires or domes or the like which occur in thermal continuity with otherwise inaccessible geological formations comprising unlimited sources of earth core heat, as to draw upon such unlimited supplies of heat at such rates and temperatures as will promote the desired chemical reaction. (auth)

GEOTHERMAL DATA AND THEORY

00192 (CONF-740209—, pp 238-250) **Instability of the Magmatic transport.** Fujii, N. (Stanford Univ., CA); Uyeda, S. 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

To estimate the potential magnitude of volcanic activity and its time variation, one of the indispensable factors will be a rate of magmatic supply to the reservoir from below or a discharge rate of volcanic materials. The flow of magma is a dissipative process in which thermal feedback may take place under some conditions. By applying the idea of thermal feedback processes, the changes in the velocity distribution and flux with the growth of instability during upward flow of magma in volcanic conduits are demonstrated. (LBS)

00193 (CONF-740209—, pp 273-286) **Preliminary estimate of global volcanic production rate.** Nakamura, K. (Univ. of Tokyo). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

Volcanic energy released during an eruption is expressed approximately as 1.5×10^{16}M (erg), where M is the total erupted mass in gram. Over 90 percent of the energy is occupied by the thermal energy. Volcanoes on the Earth's surface is classified into four groups on the basis of global tectonics. Production rates of consuming and accreting plate boundaries are estimated at about 0.75 and 4 approximately 6 km^3/year or 1 approximately 2×10^6 and 7 approximately 10×10^6 m^3/year per 100 km of their length. Production rates are estimated about approximately 1 km^3/year and approximately .1 km^3/year for volcanoes of intraoceanic and intracontinental plates, respectively. Sum of these four rates yields 6 approximately 8 km^3/year as a mean global rate of volcanic production. This figure corresponds to 1 approximately 3×10^{26} erg/year, only a few percent of the global amount of conducted heat flow. (auth)

00194 (CONF-740209—, pp 287-297) **Thermal properties of basaltic magma: results and practical experience from study of Hawaiian lava lakes. Summary.** Peck, D.L. (U.S. Geological Survey, Washington, D.C.). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The lava lakes formed by eruptions of tholeiitic basalt on the east rift zone of Kilauea volcano were studied in detail. Information was obtained on the properties of basaltic lava, on the cooling processes of ponded flows, and on techniques of drilling and inserting probes into molten lava. (LBS)

00195 (CONF-740209—, pp 307-328) **Thermal field on and around active volcanoes in Hokkaido, Japan.** Ehara, S.; Yokoyama, I. (Hokkaido, Univ., Sapporo). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

A brief summary is given of the heat flow data in volcanic areas of Hokkaido. The thermal field of active volcanoes, mainly in Hokkaido, is discussed. It is deduced that cooling of the internal heat sources of active volcanoes primarily depends on the heat discharge from the central parts and as an example at Showa-shinzan, the mass of the heat source which maintains the enormous heat discharge through a high temperature fumarole is estimated on the basis of an energy equation. It is also ascertained that the heat discharge from an active volcano would not give a large influence to the general thermal field of the surrounding areas. (LBS)

00196 (CONF-740209—, pp 330-362) **Present state of volcanology: a discussion. Session IV.** Yuhara, K.; Peck, D. (National Research Center of Disaster Prevention, Tokyo). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

A general discussion dealing with the structure and energy of volcanoes and the association of geothermal deposits with volcanoes is presented. (LBS)

00197 (CONF-740209—, pp 370-389) **On the conversion of volcanic energy to a synthetic fuel.** Harrenstien, H. (Univ. of Miami, Coral Gables, FL); Adt, R. 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The introduction of a new source of energy, volcanic energy, into the world market on a very broad scale is proposed. In order to accomplish this, a synthetic fuel, in this case hydrogen, is proposed to be generated. Heat sources, the hydrogen economy, mechanisms for hydrogen production, economics, and research and development needs are discussed. (LBS)

00198 (CONF-740209—, pp 391-414) **Morphological, hydrological and thermal characteristics of active volcanoes having no geothermal areas; and artificial hydrothermal systems for utilizing their latent internal heat energy.** Yuhara, K. (National Research Center for Disaster Prevention, Tokyo). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The following topics are discussed: relationship between the volcanoes and geothermal fields, morphological characteristics of active volcanoes having no geothermal field; ground water in volcanoes, model of hydrothermal systems; artificial hydrothermal system; thermal structure in the volcanic edifice; temperature of the thermal water in artificial hydrothermal systems; and possibility of volcanic electric power generation. (LBS)

00199 (CONF-740209—, pp 596-602) **Hydrogen as a possible intermediate in developing the geothermal resources of volcanoes in isolated locations.** Rex, R.W. (Republic Geothermal, Inc., Whittier, GA). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

The concept of a geothermal electrolytic hydrogen source as an alternative to oil and gas for electric power generation is examined. The energy cost of hydrogen is estimated to be $2.05 per 1000 cubic feet (STP) or per million BTU's. (LBS)

PROPERTIES OF AQUEOUS SOLUTIONS

00200 (CONF-740209—, pp 510-585) **Thermodynamic and hydrodynamic properties of hydrothermal systems.** Ramey, H.J. Jr.; Brigham, W.E.; Chen, H.K.; Atkinson, P.G.; Arihara, N. (Stanford Univ., CA). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

A summary is given of thermal conductivity, heat capacity, and thermal diffusivity data for rocks in hydrothermal systems. Results of investigations of temperature and pressure effect on porous media, temperature effect on relative permeability, pressure effect on pore volume, and pressure effect on permeability are reviewed. The thermodynamic and transport properties of pure and impure water are discussed, and data are presented in tabular or graphical form. Several simplified analytic forms are discussed. (LBS)

OTHER

00201 (CONF-740209—, pp 113-151) **Foci of volcanoes.** Yokoyama, I. (Hokkaido Univ., Sapporo). 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

A center of volcanic activities beneath the edifice of an active volcano, called focus of the volcano, is assumed. Foci of volcanoes are discussed under the following topics: geomagnetic changes related to volcanic activities; crustal deformations related to volcanic activities; magma transfer through volcanoes; and subsurface structure of calderas. In summary, it is concluded that the foci of volcanoes are situated at the depths 2 to 6 Km beneath them and the sources of volcanic energies may be concentrated at these depths. (LBS)

00202 (CONF-740209—, pp 226-228) **Limitations of elasticity theory in interpretation of ground surface deformation.** Decker, R.W. (Dartmouth Coll., Hanover, NH); Dieterich, J. 1974.

From U.S.-Japan cooperative science seminar on the utilization of volcano energy; Hilo, Hawaii, USA (4 Feb 1974).

Utilization of volcano energy. Proceedings of a conference, Hilo, Hawaii, February 4—8, 1974.

Magma chambers which increase in pressure or volume cause surface deformations. Measurement of the ground surface deformation thereby allows some interpretations of the shape and depth of the magma body. A review of point source and line source analytical solutions, and finite element solutions for irregularly shaped bodies, suggests that more accurate theoretical interpretations of ground surface deformation will have to consider models in which the elastic moduli are not uniform or models in which elasticity is not the only restoring stress. One possible approach is a modified finite element model in which gravity is a major vertical restoring force. The fact that gravity would have less effect on horizontal deformations may be a reason why horizontal movements generally exceed their expected value compared to vertical movements. (auth)

WIND ENERGY

00203 **Wind energy technology.** Divone, L.V. (Energy Research and Development Administration, Washington, DC). *Trans. Am. Nucl. Soc.*; 21: 143(Jun 1973).

From Transactions of the American Nuclear Society 1975 annual meeting; New Orleans, LA (8 Jun 1975).

AVAILABILITY (CLIMATOLOGY)

00204 (SAND—74-0348) **Wind power climatology of the United States.** Reed, J.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jun 1975. 163p. Dep. NTIS $7.60.

All suitable data in the National Climatic Center archives, for 758 stations, have been analyzed for monthly, seasonal, and annual average wind power. Results have been assembled in maps with equal power (isodyn) contours to show geographic regions most suitable for wind power exploitation. An appendix contains an almanac of all these wind speed distributions and power data tabulations, ordered by state and region and suitable for referencing. Wind speed versus height above ground relationships were examined with upper air climatologies at 85 kPa and 70 kPa pressure-altitude levels and certain micrometeorological research towers. An often-used rule-of-thumb appears adequate: that wind speed increases in proportion to the one-seventh power of height above ground. Thus, wind power increases with the three-sevenths power of height, for use in sizing designs for wind turbines and mounts. (15 references) (auth)

00205 (SAND—75-5295) **Some climatological estimates of wind power availability.** Reed, J.W.; Blackwell, B.F. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 6p. (CONF-750602—1). Dep. NTIS $4.00.

From 2. U. S. national conference on wind engineering research; Fort Collins, Colorado, USA (23 Jun 1975).

The Western Great Plains experiences a great flux of wind power that might be exploited. Even with conservative assumptions about collection efficiency, the supply exceeds total national demands by a factor of at least two. Wind speed increases with height above the ground friction layer, so that very large turbines, 30 to 60 m in diameter, could capture even more energy than is shown by weather station anemometer data. (8 references) (auth)

00206 (SAND—75-5531) **Wind climatology.** Reed, J.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 8p. (CONF-750615—1). Dep. NTIS $4.00.

From 2. wind energy conversion system workshop; Washington, District of Columbia, USA (9 Jun 1975).

National assessments were made to find suitable test and evaluation locations. Detailed analyses have begun of specific station records to derive parametric relationships needed for turbine design. Characteristics of long wind-speed time-series will determine selection criteria for cut-in, cut-off, and rated speed, as well as storage system dimensions. (auth)

WIND ENERGY ENGINEERING

TURBINE DESIGN AND OPERATION

00207 (SAND—75-0204) **Methods for performance evaluation of synchronous power systems utilizing the Darrieus vertical-axis wind turbine.** Banas, J.F.; Kadlec, E.G.; Sullivan, W.N. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1975. Contract AT(29-1)-789. 22p. Dep. NTIS $4.00.

Methods for calculating wind energy extraction by Darrieus vertical-axis turbines driving synchronous generators are developed. Included are the effects of turbine power coefficient, blade tip speed, generator and transmission efficiencies, and wind conditions. Example problems, using two different wind speed distributions, are presented to demonstrate the methods. A simplified economic analysis indicates that system design parameters which yield minimum cost systems are quite sensitive to wind conditions and relative component costs. Use of the methods to effect improved economic analyses is discussed. (7 references) (auth)

ELECTRIC POWER ENGINEERING

POWER GENERATION

COOLING SYSTEMS

00208 (BNWL-B—393) **U.S. ERDA dry cooling tower development program plan. Revision 1.** (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. Contract E(45-1)-1830. 75p. Dep. NTIS $5.45.

A plan is presented for a program to demonstrate the application of dry cooling for large power plants. The program effort will be centered on large-scale tests to be conducted at a 330 Mw(e) coal-fired plant being constructed at Wyodak, Wyoming. (DG)

ENVIRONMENTAL ASPECTS

00209 (NSF/RA/N—74-123, pp 63-75) **Advanced pollution control equipment.** Engdahl, R.B. (Battelle Memorial Inst., Columbus, OH). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

There are still a few concentrated areas where scarce and expensive low-sulfur fuels must be used to meet the acceptable air quality standards that have been established. This practice continues in the small, near ground-level emission sources where economics and space limitations rule out sulfur dioxide cleanup systems. An examination is made of the advanced systems that may become applicable to pollution control for larger industrial and utility fuel-burning units to enable them to use high-sulfur fuels. Technology advances on coal washing; clean gas from the Lurgi, Koppers-Totzek, Winkler, and Wellman-Galusha processes; pipeline gas from coal; solvent-refined coal; and chemically treated coal are discussed briefly. A summary is given of processes that have been demonstrated on utility boilers to remove SO_2. Utilities that are employing limestone injection, limestone scrubbing, lime scrubbing, magnesia scrubbing, alkali scrubbing, acidified water scrubbing, catalytic oxidation, adsorption on manganese oxide, and adsorption on carbon demonstration processes are identified. None of the systems are yet practical and economic for application to in-

dustrial boilers. High efficiency has been attained in fly ash collection equipment, such as electrostatic precipitators and Venturi scrubbers. (MCW)

POWER TRANSMISSION AND DISTRIBUTION

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

00210 (LA-UR—75-189) **Stabilizing superconductors for power engineering applications.** Hoffer, J.K.; Kerr, E.C.; Laquer, H.L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. 7p. (CONF-750715—1). Dep. NTIS $4.00.

From Power meeting of the IEEE; San Francisco, California, USA (20 Jul 1975).

Exhibiting essentially zero resistivity at high current densities and large magnetic fields, modern superconducting materials offer intriguing possibilities in power engineering. However, in order to utilize this property in any large scale application, the superconductor must be stable during fault and overload transients in the total system. In order to know whether the superconductor itself is stable, one must understand and control the detailed mechanisms of magnetic flux motion which occur in the material. Such flux motion will give rise to a nonzero resistivity and hence will always involve heat generation, which in turn will perturb the low temperature environment necessary to sustain superconductivity. This paper discusses the essential differences between superconductors and ordinary conductors; the control of heat generation resulting from magnetic flux motion necessary to insure that the superconductor is stable; and some experiments on models of dc superconducting transmission cables which test the theoretical assumptions. (auth)

NUCLEAR POWER PLANTS

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

00211 (GEAP—20615) **Estimating the relative probability of piping severance by fault cause.** Wilson, S.A. (General Electric Co., San Jose, Calif. (USA)). Sep 1974. Contract AT(04-3)-189. 66p. Dep. NTIS $5.45.

A comprehensive list of fault causes is prepared, and the relative contribution made by each to the probability of severance in reactor primary piping is estimated. Fault causes are identified and related to stress categories. A critical stress diagram is drawn from experimental results. The orientation of maximum value is chosen for each stress category, by type of component and joint. By judgment, conditioning probabilities of occurrence of a fault cause to a component and a crack are chosen. By judgment, a conditioning probability of nondestructive testing in a component is chosen, as well as a conditional pattern of detection probabilities, by crack size. These probabilities are used to reduce the probability values in the crack size distributions. Relative values for probability of severance are found. Results are relative to average probability of severance per location, orientation, site and pipe size. Accordingly, they do not depend on the number of components in a piping system. All input is applicable to carbon steel pipe during hot startup testing, prior to nuclear service, except that the critical stress diagram is from tests on carbon steel pipe at room temperature. The effect of this on results, and of extensions to stainless steel and to the nuclear service period, are discussed. Temperature during hot startup testing, and throughout nuclear operation, is assumed to be 550°F. (auth)

00212 (WCAP—8456) **Heavy section steel technology program technical report No. 38. Fracture toughness characterization of HSST intermediate pressure vessel material.** Mager, T.R.; Yanichko, S.E.; Singer, L.R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1974. 43p. Dep. NTIS $5.00.

For Oak Ridge National Lab., TN.

The primary objective of the Heavy Section Steel Technology (HSST) Program is to develop pertinent fracture technology to demonstrate the structural reliability of present and contemplated water-cooled nuclear reactor pressure vessels. In order to demonstrate the ability to predict failure of large, heavy-walled pressure vessels under service type loading conditions, the fracture toughness properties of the vessel's materials must be characterized. The sampling procedure and test results are presented for vessel material supplied by the Oak Ridge National Laboratory that were used to characterize the fracture toughness of the HSST Intermediate Test Vessels. The metallurgical condition and heat treatment of the test material was representative of the vessel simulated service test condition. Test specimen locations and orientations were selected by the Oak Ridge National Laboratory and are representative of flaw orientations incorporated in the test vessels. The fracture toughness is documented for the materials from each of the eight HSST Intermediate Pressure Vessels tested to date. 7 references. (auth)

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

00213 (BNL—20307) **Materials performance in operating PWR steam generators.** Weeks, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 22p. (CONF-750911—3). Dep. NTIS $4.25.

From International conference on materials for nuclear steam generators; Gatlinburg, Tennessee, USA (9 Sep 1975).

The Inconel-600 tubing in operating PWR steam generators has developed leaks due to intergranular stress corrosion cracking or a general wastage attack, originating from the secondary side of the tubing. Corrosion has been limited to those areas of the steam generators where limited coolant circulation and high heat flux have caused impurities to concentrate. Wastage or pitting attack has always been associated with local concentration of sodium hydrogen phosphates, whereas stress corrosion has been associated with local concentration of sodium or potassium hydroxides. The only instance of stress corrosion originating from the primary side occurred on cold-worked tubing when hydrogen was not added to getter oxygen, and LiOH was not added to raise the pH of the primary coolant. All PWR manufacturers are now recommending that the phosphate treatment of the secondary coolant be abandoned in favor of an all-volatile treatment. Experience in operating plants has shown, however, that removal of phosphate-rich sludge deposits is difficult, and that further wastage and/or intergranular stress corrosion may develop; the residual sodium phosphates gradually convert by reaction with corrosion product hydroxides to sodium hydroxide, which remains concentrated in the limited flow areas. Improvements in circulation patterns have been achieved by inserting flow baffles in some PWR steam generators. Inservice monitoring by eddy current techniques is useful for detecting corrosion-induced defects in the tubing, but irreproducibility in field examinations can lead to uncertainties interpreting the results. (auth)

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

00214 (CONF-750908—2) **Experimental and analytical results for a prestressed concrete reactor vessel model under simulated HTGR operating conditions.** Callahan, J.P.; Corum, J.M.; Whitman, G.D. (Oak Ridge National Lab., Tenn. (USA)). 1975. 13p. Dep. NTIS $4.00.

From 3. international conference on structural mechanics in reactor technology; London, UK (1 Sep 1975).

Prestressed Concrete Reactor Vessels (PCRVs) are unique when compared with more traditional concrete structures because of the elevated operating temperatures employed and the thorough understanding of structural behavior required to assure safety. In the United States a comprehensive program for developing and improving PCRVs has been undertaken by the Oak Ridge National Laboratory. As part of this effort, analytical methods and concrete materials characterization data have been developed. By incorporating the resulting data into an appropriate analysis method, predictions can be made of the time-dependent behavior of PCRVs subjected to anticipated nuclear reactor operating conditions. The thermal cylinder experiment described was designed to provide the information required to assess the capability of analytical methods to predict the structural behavior of operating PCRVs. (auth)

00215 (GA-A—13276) **Preirradiation report HT-28 and HT-29.** Kovacs, W.J.; Harmon, D.P. (General Atomic Co., San Diego, Calif. (USA)). 13 Jun 1975. Contract AT(04-3)-167. 37p. Dep. NTIS $4.00.

The HT-28 and 29 irradiation capsules are part of a cooperative agreement between GA and ORNL designed to evaluate irradiation performance of unbonded BISO and TRISO coated ThO_2 fertile fuel particles. The capsules will contain a total of 44 different positions uniformly divided between each capsule. The positions in HT-29 are designated for operation at 900°C over a

fast fluence increment between 5.4 to 10.7 x 10^{21} n/cm² (E > 0.18 MeV)/sub HFIR/. Positions in HT-28 are divided into two sections: 11 positions at 1250°C to receive a fast fluence exposure between 7.8 and 8.6 x 10^{21} n/cm² (E > 0.18 MeV)/sub HFIR/ and 11 positions at 900°C designed for a 4.3 to 6.9 x 10^{21} n/cm² (E > 0.18 MeV)/sub HFIR/ fast fluence exposure. Both capsuls are to serve as an evaluation test to characterize the performance of BISO OPyC coatings deposited from mixed-gas (acetylene-propylene). The OPyC variables tested will be density, coating rate, and thickness. A secondary objective of these tests will be to evaluate a TRISO coated ThO_2 design and determine the effect of coating rate and thickness on OPyC failure. (auth)

00216 (GA-A—13319) **Evaluation of corrosion: inhibiting compounds for the protection of prestressing systems.** Hildebrand, J.F. (General Atomic Co., San Diego, Calif. (USA)). 14 Feb 1975. Contract AT(04-3)-633. 6p. (CONF-750906—1). Dep. NTIS $4.00.

From International conference on PCRVs; York, UK (8 Sep 1975).

The materials and methods used to protect the tendons of the Fort St. Vrain PCRV are discussed from the point of wire manufacture, through tendon fabrication and installation, to final protection and closure of the prestressing system. The results of several inspections are presented. (auth)

00217 (GA-A—13383) **Leaktightness in HTGRs: experience at Fort St. Vrain.** Neylan, A.J.; Barker, R.A.; Deardorff, A.F. (General Atomic Co., San Diego, Calif. (USA)). 10 Jun 1975. Contract AT(04-3)-633. 9p. (CONF-750906—2). Dep. NTIS $4.00.

From International conference on PCRVs; York, UK (8 Sep 1975).

The Fort St. Vrain Prestressed Concrete Reactor Vessel is the first utilized to contain the helium coolant of a High Temperature Gas-Cooled Reactor. Because the helium coolant contains fission products, leakage from the vessel is limited to 15 percent of vessel inventory per year. The fabrication methods and development tests used to assure this leaktightness and the leakage test conducted to verify it are described. (auth)

00218 (GA-A—13553) **Effects of service environments on the behavior of HTGR steam generator structural materials.** Mazandarany, F.N.; Rittenhouse, P.L. (General Atomic Co., San Diego, Calif. (USA)). 15 Jul 1975. Contract AT(04-3)-167. 41p. (CONF-750911—6). Dep. NTIS $5.25.

From International conference on materials for nuclear steam generators; Gatlinburg, Tennessee, USA (9 Sep 1975).

The literature pertinent to water and steam corrosion of principal HTGR steam generator materials is reviewed. It is shown how this information is taken into account in the design of HTGR steam generators in the form of corrosion allowances, where required. Similarly, the available information relevant to HTGR primary coolant-metal compatibility is reviewed. Test results from on-going primary coolant compatibility studies are presented and interpreted in terms of a qualitative mechanistic model. (auth)

00219 (LA-UR—75-1321) **ZrC, a key ingredient for high temperature nuclear fuels.** Wagner, P.; Hollabaugh, C.M.; Bard, R.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 13p. (CONF-751007—4; SM—200/18). Dep. NTIS $4.00.

From IAEA international meeting on gas-cooled reactors; Julich, F.R. Germany (13 Oct 1975).

There are two basic reasons for modifying coated fuel particles for GCR use. The first is to increase the fuel body heat treatment temperature limit in order to make a higher lambda fuel matrix, the second is to raise the particle operating temperature limit. Replacement of SiC by ZrC has the potential of serving these two purposes. Predictable, controllable, and reproducible ZrC-containing particle coats have been made using the LASL-developed $ZrCl_4$ powder feeder. These coats have been made as discrete layers of ZrC or as various combinations of co-deposits of isotropic pyrolytic carbon and ZrC. The fabrication of these coats is described in detail. Irradiation tests have been performed on TRISO type particles with ZrC and on particles with gradations in the ZrC concentration in the coat. These particles had inert kernels. Test results have also been reported on TRISO particles with fissile kernels. The results of all these tests have been satisfactory. LASL-made fissile coated particles with C-ZrC graded coats, and ZrC coated particles with carbon kernels and variable stoichiometry in the ZrC are currently being irradiated. Thus far, all laboratory and high temperature irradiation test results on the ZrC containing coated particles look as good as or better than comparable test results on SiC containing particles. At this point in time, indications are that ZrC coated particles will fulfill their promise in extending the high temperature limit in gas cooled reactors. (auth)

00220 (ORNL-TM—4882) **Review of HTGR coated fuel particle stability.** Morgan, M.T. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 29p. Dep. NTIS $4.00.

The stability of coated fuel particles in high-temperature, gas-cooled reactors as a function of burnup, fast-neutron fluence, irradiation time, and temperature is reviewed; the effect of coating design parameters was not considered. The purpose of the review is to establish limits of coated particle performance and, in particular, to validate diagrams in which coating failure during abnormal temperature excursions is plotted vs previous irradiation time. (auth)

00221 (UNI-SA—13) **N Reactor steam generator performance.** Carlson, P.A; Kratzer, W.K.; Larrick, A.P.; Schmidt, J.P. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 4 Aug 1975. Contract AT(45-1)-1857. 17p. (CONF-750911—4). Dep. NTIS $4.00.

From International conference on materials for nuclear steam generators; Gatlinburg, Tennessee, USA (9 Sep 1975).

A description is given of the performance of the twelve N Reactor steam generators. Maintenance and modifications carried out during the operating history of the reactor are discussed. (DG)

POWER REACTORS, BREEDING

00222 (ANL—75-33) **Application of the collocation method using hermite cubic splines to nonlinear transient one-dimensional heat-conduction problems.** Chawla, T.C.; Leaf, G.; Chen, W.L.; Grolmes, M.A. (Argonne National Lab., Ill. (USA)). Jul 1975. Contract W-31-109-Eng-38. 36p. Dep. NTIS $4.00.

A collocation method for the solution of one-dimensional parabolic partial differential equations using Hermite splines as approximating functions and Gaussian quadrature points as collocation points is described. The method consists of expanding dependent variables in terms of piecewise cubic Hermite splines in the space variable at each time step. The unknown coefficients in the expansion are obtained at every time step by requiring that the resultant differential equation be satisfied at a number of points (in particular, at the Gaussian quadrature points) in the field equal to the number of unknown coefficients. This collocation procedure reduces the partial differential equation to a system of ordinary differential equations which is solved as an initial-value problem using the steady-state solution as the initial condition. The method thus developed is applied to a two-region nonlinear transient heat-conduction problem and compared with a finite-difference method. (4 references) (auth)

00223 (ANL-CT—75-40) **Dynamic response of two parallel circular cylinders in a liquid.** Chen, S.S. (Argonne National Lab., Ill. (USA)). May 1975. Contract W-31-109-eng-38. 35p. Dep. NTIS $4.75.

The problem of two parallel circular cylinders vibrating in a liquid is studied analytically. The equations of motion including fluid coupling are formulated using the added mass concept. A closed form solution and an approximate solution are obtained for free vibration. The steady state responses of two cylinders subjected to harmonic excitations are presented. The results illustrate the significance of the interaction of two structures in a liquid. (auth)

00224 (ANL-RDP—41) **Reactor development program. Progress report, June 1975.** (Argonne National Lab., Ill. (USA)). Jun 1975. Contract W-31-109-Eng-38. 208p. AT.

Progress is reported in the following areas: (1) EBR-2 operations and testing, (2) LMFBR design support, (3) instrumentation and control, (4) fuels and materials development, (5) reactor physics, (6) reactor safety, and (7) GCFR studies. (JWR)

00225 (BNWL-B—85) **Pre-experiment analysis for MSBR-1 experiment.** Lippincott, E.P.; Davis, E.C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1971. Contract AT(45-1)-1830. 18p. Dep. NTIS $4.00.

A reactor lattice physics experiment planned for the High Temperature Lattice Test Reactor in support of the Molten Salt Breeder Reactor program is analyzed. (JWR)

00226 (CONF-750607—24) **Status of the Clinch River breeder reactor plant nuclear steam supply system.** Jacobi, W.M. (Westinghouse Electric Corp., Baltimore, Md. (USA)). [nd]. 6p. Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The status of the CRBR project is reviewed. Major accomplishments have been achieved by the Project. Supporting the major milestones, system design descriptions and equipment

specifications have been completed by the reactor manufacturers and architect engineer. Major milestone events, such as preparation of the Environmental Report and the Preliminary Safety Analysis Report, have been completed. (auth)

00227 (CONF-750617—20) **Simplified inelastic (plastic and creep) analysis of pipe elbows subjected to inplane and out-of-plane bending.** Mello, R.M.; Scheller, J.D. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Dec 1974. Contract AT(11-1)-3045. 38p. Dep. NTIS $5.00.

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

The inelastic analysis of elbows typical of use in Liquid Metal Fast Reactor piping systems is described. Detailed information on stresses, plastic and creep strains, and deformations throughout the elbow bodies resulting from elastic/plastic, elastic/plastic/creep, and elastic/plastic-creep/relaxation material behavior was obtained for the cases of applied inplane and out-of-plane moment loading on the elbows. Some conclusions are made concerning the nature of the resulting stresses in the elbows. The simplified pipe-bend element in the MARC nonlinear finite element program is used as the analytical tool. This element permits nonlinear analysis of piping elbows and pipeline systems at realistic cost. (auth)

00228 (CONF-750812—3) **Clinch River breeder reactor plant.** Hardigg, G.W. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). [nd]. 25p. Dep. NTIS $4.25.

From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).

The planning and design activities for the Clinch River Breeder Reactor are reviewed. (JWR)

00229 (CONF-750911—1) **Mechanical and physical properties of 2 1/4 Cr—1 Mo steel in support of CRBRP steam generator design.** Brinkman, C.R.; Williams, R.K.; Klueh, R.L.; Hebble, T.L. (Oak Ridge National Lab., Tenn. (USA)). 1975. 43p. Dep. NTIS $5.25.

From International conference on materials for nuclear steam generators; Gatlinburg, Tennessee, USA (9 Sep 1975).

Mechanical and physical property tests on annealed $2^1/_4$ Cr-1 Mo steel were conducted in an effort to define behavior in support of the design of the Clinch River Breeder Reactor Plant (CRBRP) steam generator design. Interim empirical expressions and/or data are reported from the results of tensile, creep, fatigue, creep-fatigue, subcritical crack growth, thermal conductivity, thermal diffusivity, and thermal expansion tests and analysis. These expressions cover behavior, where appropriate, over a range of temperatures from 25 to as high as 700°C. Comparisons between thermal conductivity and diffusivity values and those found in the American Society of Mechanical Engineers (ASME) Code indicated that the new values were significantly higher than those found presently in the Code. The importance and complexity of obtaining valid mechanical and physical properties for the Clinch River Breeder Reactor Plant (CRBRP) steam generator are discussed. (auth)

00230 (CONF-750916—1) **Nuclear welding, application for an LMFBR.** Patriarca, P.; Goodwin, G.M. (Oak Ridge National Lab., Tenn. (USA)). 1975. 38p. Dep. NTIS $5.00.

From 4. army materials technology conference, advances in joining technology; Boston, Massachusetts, USA (16 Sep 1975).

Fabrication of an LMFBR system is discussed, with emphasis on areas where joint welding innovations have been introduced. Each major component of the system, including reactor vessel, intermediate heat exchanger, steam generator, and sodium-containment piping, is treated separately. Developmet of special filler metals to avoid the low elevated-temperature creep ductility obtained with conventional austenitic stainless steel weldments is reported. Bore-side welding of steam generator tube-to-tubesheet joints with and without filler metal is desirable to improve inspectability and eliminate the crevice inherent with face-side weld design, thus minimizing corrosion problems. Automated welding methods for sodium-containment piping are summarized which iminimize and control distortion and ensure welds of high integrity. Selection of materials for the various components is discussed for plants presently under construction, and materials predictions are made for future concepts. (auth)

00231 (COO—2245-20TR) **Prediction of coolant temperature field in a breeder reactor including interassembly heat transfer.** Chen, B.C.J.; Todreas, N.E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). May 1975. Contract AT(11-1)-2245. 133p. Dep. NTIS $5.45.

A general procedure for investigating the effect of the interassembly heat transfer on the temperature field of a breeder reactor is provided. This procedure utilizes a simple multiassembly code, SUPERENERGY, and a set of normalized assembly maps derived from this code. This procedure was applied to the Clinch River Breeder Reactor to study the effect of including various concentric rings of coupled assemblies on the temperature prediction of the central assembly. Insignificant perturbation from the inclusions of second ring assemblies and important perturbation from the inclusion of first ring assemblies was found. (auth)

00232 (COO—2245-22TR) **Turbulent momentum exchange coefficients for reactor fuel bundle analysis.** Ninokata, H.; Todreas, N.E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Jun 1975. Contract AT(11-1)-2245. 89p. Dep. NTIS $5.45.

A unified treatment of the turbulent and the molecular effects on the mixing coefficients has been performed and the momentum exchange coefficient evaluated for small triangular array rod bundles (19 pins and 37 pins) without spacers. These results are based on the output of the computer code "VELASCO" which performs the calculation of the velocity distribution within a fuel rod array. The results show that momentum exchange coefficients vary considerably with spatial position in the bundle. A method for deriving energy exchange coefficients as input data for COBRA analysis is presented. These energy exchange coefficients can be calculated by the method of this report when VELASCO or a similar distributed parameter code is developed to compute thermal fields within a fuel rod array. (auth)

00233 (COO—2426-13) **Preliminary assessment of the impact of carbide fueled subassemblies in the CRBRP.** Vitti, J.A. (ed.). (Combustion Engineering, Inc., Windsor, Conn. (USA)). Aug 1975. Contract AT(11-1)-2426. 124p. (CEND—371). AT.

Although LMFBR design studies with mixed carbide fuel have consistently yielded superior breeding gain, fuel cycle cost, and doubling time performance, the development of mixed carbide fuel has lagged considerably behind that of mixed oxide. Consequently, mixed oxide has been chosen as the reference for CRBRP. An accelerating government-supported advanced LMFBR fuels development program, however, is expected to provide sufficient experience with mixed carbide fuel to permit its use sometime during the plant life of the CRBRP. The prime objective of this preliminary study is to examine the impact of inserting carbide subassemblies in place of the reference oxide subassemblies in the CRBRP. (auth)

00234 (GA-A—13298) **Postirradiation examination of charcoal trap in irradiation capsule GB-9.** Langer, S.; Buzzelli, G.; Flynn, P.W. (General Atomic Co., San Diego, Calif. (USA)). 28 May 1975. Contract AT(04-3)-167. 40p. Dep. NTIS $4.00.

A vented fuel rod containing mixed-oxide fuel, a urania axial blanket, and a fission-product charcoal trap was irradiated in GCFR irradiation capsule GB-9 in the Oak Ridge Research Reactor. The postirradiation examination of the charcoal trap from capsule GB-9 was carried out at General Atomic Company. The postirradiation examination is described, the axial distributions and concentrations of several cesium and iodine fission-product nuclides deposited in the trap are reported, and the fractional depositions and probable transport mechanisms are discussed. (auth)

00235 (GA-A—13423) **Review of the literature pertinent to fission-product migration and interaction in fuel rods.** Epstein, B.D. (General Atomic Co., San Diego, Calif. (USA)). 6 Jun 1975. Contract AT(04-3)-167. 39p. Dep. NTIS $4.00.

A survey of the available literature pertaining to the volatile fission-product activity in fast breeder reactor fuel has been conducted. This is an initial effort in the investigation of plateout (or deposition) and potential plugging in the Gas-Cooled Fast Breeder Reactor (GCFR) fuel pressure-equalization system (PES). A review of the material surveyed and the results and conclusions reached with respect to pressure-equalized and vented GCFR fuel rods is presented. (auth)

00236 (HEDL-SA—981) **Postulated accident conditions for air cleaning systems and radiological dose assessments for containment options.** Hilliard, R.K.; Postma, A.K. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract AT(45-1)-2170. 43p. (CONF-750719—4). Dep. NTIS $5.25.

From Safety technology meeting on radiological consequence assessment; Canoga Park, California, USA (29 Jul 1975).

Ambient conditions and performance requirements for emergency air cleaning systems applicable to commercial LMFBR plants were studied. The focus of this study centered on aerosol removal under hypothetical core disruptive accident conditions. Effort completed includes a review of air cleaning systems related to LMFBR plants, selection of three reference containment system designs, postulation of the EACS design basis accident (EACS-DBA), analysis of thermal conditions resulting from the DBA,

analysis of aerosol transport behavior following the DBA, and an estimate of bone dose at the site boundary for each of the reference plant designs. Reference plant concepts were a single containment system (e.g., FFTF), a double containment system (e.g., CRBRP with closed head compartment), and a containment-confinement design in which an inerted, sealed primary volume was located within a ventilated building whose exhaust was filtered. The reference design basis accident selected here involved release to the inner containment system of 1 percent of non-volatile solids and plutonium, 25 percent of core halogens, 25 percent of core volatile solids, 100 percent of core noble gases, 68 lbs of sodium vapor and 5000 lbs of liquid sodium. 13 references. (auth)

00237 (HEDL-SA—982) **Emergency air cleaning system development for LMFBR containments.** McCormack, J.D.; Hilliard, R.K.; Postma, A.K.; Muhlestein, L.D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract AT(45-1)-2170. 24p. (CONF-750719—1). Dep. NTIS $4.25.

From Safety technology meeting on radiological consequence assessment; Canoga Park, California, USA (29 Jul 1975).

Criteria for evaluating the various types of Emergency Air Cleaning Systems which may be used in LMFBR plants have been established for both single containment and containment-confinement arrangements. These two plant arrangements have quite different air cleaning requirements for postulated design base accident conditions. Work is currently in progress to select from a list of candidate air cleaning systems those which best meet the criteria requirements. By means of a weighted rating system, areas of strength or weakness can be found and the conceptual system design then optimized. The final system arrangements will be ranked and several of the most promising systems selected for large-scale tests in the former CSE vessel at Hanford. 8 references. (auth)

00238 (HEDL-SA—984) **Experimental plans for aerosol behavior tests in a large vessel.** Hilliard, R.K.; Muhlestein, L.D.; McCormack, J.D.; Postma, A.K. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract AT(45-1)-2170. 13p. (CONF-750719—3). Dep. NTIS $4.00.

From Safety technology meeting on radiological consequence assessment; Canoga Park, California, USA (29 Jul 1975).

Four tests in a large containment vessel (67 feet high by 25 feet in diameter) are currently under consideration in the HEDL Emergency Air Cleaning System development program. These tests are aimed primarily at developing baseline information on aerosol behavior for use in large-scale tests of emergency air cleaning systems. Experimental data will be obtained to permit comparison of results with predictions based on computer models such as HAA-3B. Test AB-1 will essentially be a size scale-up of earlier tests conducted at Atomics International which provided the basis for the HAA-3B code. Test AB-2 will duplicate test AB-1 except that moisture (to simulate water released from heated concrete) will be added to the containment atmosphere. Test AB-3 will be similar to test AB-1, but will use a sodium spray fire rather than pool fire as an aerosol source. Test AB-4 will use UO_2 and I aerosols and vapor as well as sodium oxide. (auth)

00239 (HEDL-TME—74-30) **Some aspects of continuum physics used in fuel pin modeling.** Bard, F.E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1975. Contract AT(45-1)-2170. 154p. Dep. NTIS $5.45.

The mathematical formulation used in fuel pin modeling is described. Fuel pin modeling is not a simple extension of the experimental and interpretative methods used in classical mechanics. New concepts are needed to describe materials in a reactor environment. Some aspects of continuum physics used to develop these new constitutive equations for fuel pins are presented. (auth)

00240 (HEDL-TME—75-51) **Exposure of precracked and preloaded fracture mechanics specimens in liquid sodium, with an intermediate moist nitrogen cleaning.** James, L.A.; Borisch, R.R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2170. 21p. Dep. NTIS $4.00.

A survey is presented on the applicability of fracture mechanics techniques in characterizing the potential for crack extension when reactor components are removed from service in a sodium environment, cleaned, and subsequently returned to service. It was felt that sodium remaining in a sharp crack after a component is removed from service could react with the cleaning environment and, with the application of tensile stresses, result in environmentally aggravated crack extension. Precracked and preloaded fracture mechanics specimens were exposed to sodium, cleaned, returned to sodium environment, and finally examined. No crack extension occurred in any of the statically loaded specimens during the test. (auth)

00241 (HEDL-TME—75-75) **Concrete protection from sodium spills by intentionally defected liners, small-scale tests S9 and S10.** Hilliard, R.K.; Boehmer, W.D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-2170. 41p. Dep. NTIS $4.00.

Two small scale tests were performed to determine the protection against sodium attack afforded to a concrete surface by a defected steel liner. An inert atmosphere was maintained over the sodium pool, which was heated electrically to 1600°F for 2—6 hrs in one test, to 1380°F for 19 hrs in the other. The 10 inch diameter vertical concrete surface was separated from the sodium by a liner plate in which small defects had been drilled. The plates provided significant protection against direct chemical attack, but most of the water was released from the concrete through the defects to react in the sodium pool region. The liners were corroded significantly in the defect areas. (auth)

00242 (ORNL-TM—4886) **Analysis of failed category II electric heaters that simulate LMFBR fuel pins.** Martin, M.M.; Clark, D.L. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 54p. AT.

Examination of prematurely failed high-performance electrical heaters, which simulate LMFBR fuel pins, revealed that all had been damaged similarly during operational testing. Failure culminated in severance of their heating elements and, in most instances, penetration of their type 316 stainless steel sheaths. All contained indications of incipient failure in that their heating elements of KANTHAL A-1 alloy had partially melted at numerous locations. A mechanism for the generation of internal nitrogen pressure from the boron nitride insulation on molten heating elements was suggested. The principal reason for incipient failure was inadequate transfer of heat from the heating element into the surrounding boron nitride insulation. Adverse preferred orientation and numerous low-density regions reduced the effective thermal properties of the boron nitride insulation and thereby contributed to failure of the heaters. (auth)

00243 (WAPD-TM—1172) **Chemical and spectrochemical production analysis of ThO_2 and $^{233}UO_2$-ThO_2 pellets for the light water breeder reactor core for Shippingport (LWBR development program).** Bukowski, J.F.; Hollis, E.D. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). Jun 1975. Contract AT(36-1)-GEN-14. 119p. Dep. NTIS $9.00.

The Bettis Atomic Power Laboratory has utilized wet chemical, emission spectrochemical, and mass spectrometric analytical techniques for the production analysis of the ThO_2 and $^{233}UO_2$-ThO_2 (1 to 6 wt percent $^{233}UO_2$) pellets for the Light Water Breeder Reactor (LWBR) core for Shippingport. Proof of the fuel breeding concept necessitates measurement of precise and accurate chemical characterization of all fuel pellets before core life. Chemistry's efforts toward this goal are presented in three main sections: (1) general discussions relating the chemical requirements for ThO_2 and $^{233}UO_2$-ThO_2 core materials to the analytical capabilities, (2) technical discussions of the chemical and instrumental technology applied for the analysis of aluminum, boron, calcium, carbon, chloride plus bromide, chromium, cobalt, copper, dysprosium, europium, fluoride, gadolinium, iron, magnesium, manganese, mercury, molybdenum, nickel, nitrogen, samarium, silicon, titanium, vanadium, thorium, and uranium (total, trace, and uranium VI), and (3) a formal presentation of the analytical procedures as applied to the LWBR Development Program. (auth)

00244 (WARD—5558) **Seismic design criteria for the Clinch River Breeder Reactor Plant.** Morrone, A.; Bitner, J.L.; Sigal, G.B. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1975. 34p. (CONF-750617—19). Dep. NTIS $4.75.

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

The general criteria for seismic resistant design for structures, systems and components of the Clinch River Breeder Reactor Plant (CRBRP) are presented and discussed. Site dependency of the maximum ground accelerations for the Operating Basis Earthquake and the Safe Shutdown Earthquake is described from the viewpoint of historical records and geological and seismological studies for the CRBRP site. The respective ground response spectra are derived by normalization of the latest AEC Regulatory standard shapes to these maximum ground accelerations. Modeling and analytical techniques and requirements are given. In addition, loading conditions and categories, loading combinations, earthquake direction effects and allowable damping values are defined. A discussion of the testing criteria which considers both single and multiple frequency test motions, and basic test procedures for single frequency sine beat testing is presented. (auth)

00245 Reliability evaluation of a sodium heated steam generator. Gangadharan, A.C.; Gupta, G.D.; Berman, I. (Foster Wheeler Energy Corp., Livingston, NJ). pp 51-68 of **Reliability engineering in pressure vessels and piping.** Gangadharan, A.C. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

See CONF-750617—18.

A description is given of the application of failure mode and effects analysis for reliability evaluation of a sodium heated steam generator design which was proposed for the Clinch River Breeder Reactor Project. The basic ideas involved in reliability, maintainability, and safety analysis are briefly reviewed. The methods available to conduct such studies are outlined. The impact of coordinating reliability studies with other facets of a design process is emphasized. (auth)

00246 Thermal ratchetting in pipes subjected to intermittent thermal downshocks at elevated temperatures. Corum, J.M.; Young, H.C.; Grindell, A.G. (Oak Ridge National Lab., TN). pp 47-58 of **Pressure vessels and piping: verification and qualification of inelastic analysis computer programs.** Corum, J.M.; Wright, W.B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

See CONF-750617—16.

Many of the structural design problems requiring inelastic analyses in high-temperature, liquid-metal-cooled reactor system components result from the frequent thermal transients that can occur. These transients can, if sufficiently severe, produce progressive inelastic deformations (ratchetting). The results of two thermal ratchetting tests on straight sections of pipe are presented. The pipes, each of which was machined from a well-characterized heat of Type 304 stainless steel, were subjected to a series of thermal downshocks on their inner surface, followed by sustained periods under an internal pressure loading at a temperature of 1100°F. Testing was carried out in a special sodium test facility built for the purpose, and the outer surface strain histories were measured using high-temperature capacitive strain gages. The circumferential strain responses, which typify the inelastic behaviors, are presented. (auth)

00247 (LA-tr—75-14) **Layout, irradiation, and post-irradiation-examination of the short-time, mixed-carbide-irradiation-experiment loop-4A.** Weimar, F.; Fiedler, H. (Kernforschungszentrum Karlsruhe (F.R. Germany)). 1975. 95p. Dep. NTIS $7.75.

As a possible fissionable fuel, uranium carbide stands at the center of the PSB program to develop a high-quality fuel for the fast breeder. Irradiation experiments to show both the long-term and initial behavior of the uranium carbide are described. The initial behavior is tested in the FR 2-Central-Loop by means of a device which allows the experimenter to move the test sample in, out, and to a new height while the reactor is running. The experimental group comprises 8 test bodies with central thermoelements, with various large radial clearances between the casing tube and the carbide pellet. All details concerning the 8 test bodies of this experimental group are given. These details include a statement of the problem, the layout, specifications, production of the test bodies, radiation course, non-destructive and destructive post-irradiation examination as well as calculations with the fuel rod-computer program SATURN. (20 references) (auth)

00248 Orifice design for the control of coupled region flow. Atherton, R.; Spadaro, P.R.; Brummerhop, F.G. (to U.S. Energy Research and Development Administration). US Patent 3,878,870. 22 Apr 1975. Filed date 16 Apr 1974. 20p.

PAT-APPL-461,316.

A fluid system arrangement for nuclear reactors is described comprising a triplate orifice apparatus which simultaneously controls core flow distribution, flow rate ratio between hydraulically coupled regions of the blanket and radial static pressure gradients entering and leaving the blanket fuel region. The design of the apparatus is based on the parameters of the diameter of the orifice holes, the friction factor, and expansion, contraction and turning pressure loss coefficients of the geometry of each orifice region. These above parameters are properly matched to provide the desired pressure drop, flow split and negligible cross flow at the interface of standard and power-flattened open lattice blanket regions. (Official Gazette)

00249 Method of detecting a fuel element failure. Cohen, P. (to U.S. Energy Research and Development Administration). US Patent 3,881,989. 6 May 1975. Filed date 23 Jul 1973. 9p.

PAT-APPL-381,633.

A method is described for detecting a fuel element failure in a liquid-sodium-cooled fast breeder reactor consisting of equilibrating a sample of the coolant with a molten salt consisting of a mixture of barium iodide and strontium iodide (or other iodides) whereby a large fraction of any radioactive iodine present in the liquid sodium coolant exchanges with the iodine present in the salt; separating the molten salt and sodium; if necessary, equilibrating the molten salt with nonradioactive sodium and separating the molten salt and sodium; and monitoring the molten salt for the presence of iodine, the presence of iodine indicating that the cladding of a fuel element has failed. (Official Gazette)

00250 Modular core component support for nuclear reactor. Finch, L.M.; Anthony, A.J. (to U.S. Energy Research and Development Administration). US Patent 3,888,731. 10 Jun 1975. Filed date 15 Mar 1973. 10p.

PAT-APPL-341,612.

The core of a nuclear reactor is made up of a plurality of support modules for containing components such as fuel elements, reflectors and control rods. Each module includes a component support portion located above a grid plate in a low-pressure coolant zone and a coolant inlet portion disposed within a module receptacle which depends from the grid plate into a zone of high-pressure coolant. Coolant enters the module through aligned openings within the receptacle and module inlet portion and flows upward into contact with the core components. The modules are hydraulically balanced within the receptacles to prevent expulsion by the upward coolant forces. (Official Gazette)

00251 Fluidized-bed nuclear reactor. Grimmett, E.S.; Kunze, J.F. (to U.S. Energy Research and Development Administration). US Patent 3,888,733. 10 Jun 1975. Filed date 21 Dec 1973. 12p.

PAT-APPL-427,391.

A reactor vessel containing a fluidized-bed region of particulate material including both a neutron-moderating and a fertile substance is described. A gas flow including fissile material passes through the vessel at a sufficient rate to fluidize the particulate material and at a sufficient density to support a thermal fission reaction within the fluidized-bed region. The high-temperature portion of a heat transfer system is located within the fluidized-bed region of the reactor vessel in direct contact with the fluidized particles. Heat released by fission is thereby transferred at an enhanced rate to a coolant circulating within the heat transfer system. Fission products are continuously removed from the gas flow and supplemental fissile material added during the reactor operation. (Official Gazette)

REGULATION AND LICENSING

00252 (FIND—50524) **FIND: Alan R. Barton Nuclear Plant, Units 1, 2, 3, and 4.** Hendricks, P.L. (ed.). (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jul 1975. 37p. (FIND—50527). Dep. NTIS $4.00.

An index is presented for microfiche items 1 through 37 received by U. S. ERDA-TIC through April 24, 1975, for Docket 50524/50527. This material has been submitted by Alabama Power Company in conjunction with its application for construction permit and operating license for the Alan R. Barton Nuclear Plant, Units 1, 2, 3, and 4. Topics covered are in the license, technical, and environmental categories. Citations refer to items and grid coordinates and are given for major headings or topics of primary interest. (auth)

00253 (NRCI—75/3) **Nuclear Regulatory Commission issuances, March 1975.** (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Apr 1975. 120p. TIC $2.50.

Reactor licensing actions taken by the Nuclear Regulatory Commission, the Atomic Safety and Licensing Appeal Board and the Atomic Safety and Licensing Boards for March 1975 are presented. Action was included for the following reactors: Big Rock Point Nuclear Plant; West Valley Reprocessing Plant; Limerick Generating Station, Units 1 and 2; Midland Plants, Units 1 and 2; Wolf Creek Generating Station, Unit 1; Monticello Nuclear Generating Plant, Unit 1; Douglas Point Nuclear Generating Station, Units 1 and 2; Seabrook Station, Units 1 and 2; Vermont Yankee Nuclear Power Station; and WPPSS Hanford Units 1 and 4. (PCS)

00254 (NRCI—75/6) **Nuclear Regulatory Commission issuances, June 1975.** (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Aug 1975. 202p. TIC $4.00.

Issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), and the Atomic Safety and Licensing Boards (LBP) are presented. (auth)

ECONOMICS

00255 (ORNL—4995) **Assessment of industrial energy options based on coal and nuclear systems.** Anderson, T.D.; Bowers, H.I.; Bryan, R.H.; Delene, J.G.; Hise, E.C.; Jones, J.E. Jr.; Klepper, O.H.; Reed, S.A.; Spiewak, I. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 330p. Dep. NTIS $10.60.

Industry consumes about 40 percent of the total primary energy used in the United States. Natural gas and oil, the major industrial fuels, are becoming scarce and expensive; therefore, there is a critical national need to develop alternative sources of industrial energy based on the more plentiful domestic fuels—coal and nuclear. This report gives the results of a comparative assessment of nuclear- and coal-based industrial energy systems which includes technical, environmental, economic, and resource aspects of industrial energy supply. The nuclear options examined were large commercial nuclear power plants (light-water reactors or high-temperature gas-cooled reactors) and a small [approximately 300-MW(t)] special-purpose pressurized-water reactor for industrial applications. Coal-based systems selected for study were those that appear capable of meeting environmental standards, especially with respect to sulfur dioxide; these are (1) conventional firing using either low- or high-sulfur coal with stack-gas scrubbing equipment, (2) fluidized-bed combustion using high-sulfur coal, (3) low- and intermediate-Btu gas, (4) high-Btu pipeline-quality gas, (5) solvent-refined coal, (6) liquid boiler fuels, and (7) methanol from coal. Results of the study indicated that both nuclear and coal fuel can alleviate the industrial energy deficit resulting from the decline in availability of natural gas and oil. However, because of its broader range of application and relative ease of implementation, coal is expected to be the more important substitute industrial fuel over the next 15 years. In the longer term, nuclear fuels could assume a major role for supplying industrial steam. (auth)

CONSTRUCTION AND OPERATION

00256 (BNL—20273) **Economics of the production of liquid fuel and fertilizer by the fixation of atmospheric carbon and nitrogen using nuclear power.** Baron, S.; Steinberg, M. (Brookhaven National Lab., Upton, N.Y. (USA)). Jan 1975. 21p. (CONF-750812—12). Dep. NTIS $4.25.

From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).

The increasing cost and the limited reserves of natural gas and oil in the U. S. are shifting the economics in favor of nuclear energy as a means of carbon and nitrogen fixation. Methanol blended with gasoline up to 30 percent by volume increases the performance of cars and reduces the emission of carbon monoxide without the need of catalytic converters. Longer term development of engines operating on 100 percent methanol will permit total elimination of pollutants from auto exhausts. Most important, the capital investment for methanol synthesis is less than oil and gas exploration and eliminates the need for refineries. The environment with methanol fuel will be unchanged with the recycling of CO_2 and H_2O combustion products. The production of ammonia by nuclear power fixation appears to be competitive with the traditional processes using natural gas and oil. Both the methanol and ammonia plants can be part of energy parks producing power, transportation fuels, fertilizer, as well as synthetic foodstuff, under clean environmental conditions, and at costs competitive with present-day polluting technology. (auth)

FUEL CYCLE

00257 (ORNL—4988) **Inventory charge calculations in the nuclear fuel cycle.** Salmon, R. (Oak Ridge National Lab., Tenn. (USA)). Sep 1975. Contract W-7405-eng-26. 262p. Dep. NTIS $7.60.

Simplified methods are presented for the calculation of inventory charges or carrying charges on fuel, which represent the indirect component of the fuel cycle cost. These methods permit rapid calculation of the changes in fuel cycle cost caused by changes in the amount or timing of fuel cycle expenditures. The methods are developed by applying the discounted cash flow procedure to a single batch of fuel. In typical cases, this would be a batch representing equilibrium or steady-state reactor operation. The cost equations used are the same as those used in the computer code REFCO, described in ORNL-4695, which was based on the discounted cash flow procedure with continuous discounting. Equivalent procedures using the fixed charge rate concept also are developed. This is done in such a way that consistency with the discounted cash flow procedure is maintained. The fixed charge rate used here is defined in terms of tax rates and the interest rates on debt and equity capital. An effective inventory time is also defined. This is a function of the lead or lag time, the interest rates on capital, and the exposure time of the batch. Tabulated values of the effective inventory time and other useful functions, such as the ratio of indirect to direct cost, are included. Cost calculations using these tables agree with those produced by REFCO, the accuracy being within 0.001 mill/kWhr in the cases studied. (auth)

00258 **Nuclear fuel cycle.** Larson, H.J. (Atomic Energy Commission, Washington, DC). pp vp of **Plutonium, safeguards, and the breeder.** New York; Atomic Industrial Forum, Inc. (1975).

From AIF public affairs workshop on plutonium, safeguards, and the breeder; Knoxville, Tennessee, USA (8 Oct 1974).

See CONF-7410119—.

An overview of the fuel cycle as it exists and is projected in the U. S. is presented. The economics and necessary facilities for fuel reprocessing, plutonium recycle, waste management, and spent fuel shipment are discussed. (HDR)

00259 **Design and manufacture of gas tags for FFTF fuel and control assemblies.** Strand, C.A.; Schenter, R.E. (Westinghouse Hanford Co., Richland, WA). *Nucl. Technol.*; **26**: No. 4, 472-479(Aug 1975).

The Fast Flux Test Facility being built near Richland, Washington, for materials and component testing for developmant of the liquid-metal fast breeder reactor will employ "gas tagged" for locating failed fuel and control elements in the Fast Test Reactor (FTR). The fuel and control pins are "gas tagged" by loading a capsule with specially blended krypton and xenon isotopes. The encapsulation of the tag gas employs a unique application of laser technology: stainless-steel capsules within a sealed glass-covered fixture containing the tag gas arefirst pierced and then seal welded with a laser beam. After inspection, the capsules are loaded in pins, and the gas is released by piercing the capsule with an electromagnetically activated internal penetrator. If the pin should develop a leak, the gas is released and the defect assembly is then located by mass spectrometric analysis of the reactor cover gas. Capsule filling yield for 40,000 capsules fabricated for 2 FTR cores was approximately95 percent. 10 references. (auth)

NUCLEAR REACTOR TECHNOLOGY

00260 (ANCR—1177) **Nuclear Technology Division annual progress report for period ending June 30, 1974.** (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jan 1975. 570p. Dep. NTIS $13.60.

Abstracts of research projects are presented concerning nuclear properties, general reactor development and support, test reactor operations support, LOFT support, PBF support, FEFPL support, TRSP support, techniques and instrumentation, nonnuclear energy sources, and related activities of division personnel. (DCC)

00261 (BNWL-B—435) **Availability of useful isotopes from civilian nuclear power reactors to the year 2000.** Heeb, C.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. Contract E(45-1)-1830. 36p. Dep. NTIS $4.00.

Various fission product and actinide isotopes are present in fuels discharged from nuclear power reactors. Many of these isotopes have potential for beneficial use such as generators of thermal and/or electrical energy. Knowledge of the character and amount of these isotopes present in fuels discharged from nuclear power reactors is needed to define the current and potential use of these by-products and methods of recovery. Thus, the purpose of this study was to make a preliminary estimate of the cumulative amount from all reactors in the U. S. civilian nuclear power economy of each of those isotopes deemed as having the greatest potential for application. The time period covered is from 1972 to the year 2000. (auth)

THEORY AND CALCULATION

00262 (ANL—75-2) **Proceedings of the NEACRP meeting of a Monte Carlo study group, July 1—3, 1974, Argonne, Illinois.** Hytry, C. (comp.). (Argonne National Lab., Ill. (USA)). 1974. Contract W-31-109-eng-38. 341p. (CONF-740710—; NEACRP-L—118). Dep. NTIS $10.60.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Separate abstracts are included for each of the 17 papers presented concerning the use of Monte Carlo techniques in reactor physics studies. (DCC)

00263 (ANL—75-2, pp 5-22) **Efficient data management techniques implemented in the Karlsruhe Monte Carlo code KAMCCO.** Arnecke, G.; Borgwaldt, H.; Brandl, V.; Lalovic, M. (Kernforschungszentrum, Karlsruhe, Ger.). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

The Karlsruhe Monte Carlo Code KAMCCO is a forward neutron transport code with an eigenfunction and a fixed source option, including time-dependence. A continuous energy model is combined with a detailed representation of neutron cross sections, based on linear interpolation, Breit-Wigner resonances and probability tables. All input is processed into densely packed, dynamically addressed parameter fields and networks of pointers (addresses). Estimation routines are decoupled from random walk and analyze a storage region with sample records. This technique leads to fast execution with moderate storage requirements and without any I/O-operations except in the input and output stages. 7 references. (auth)

00264 (ANL—75-2, pp 23-52) **General Monte Carlo code MONK.** Moore, J.G. (UKAEA, Culcheth, Eng.). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

The Monte Carlo code MONK is a general program written to provide a high degree of flexibility to the user. MONK is distinguished by its detailed representation of nuclear data in point form i.e., the cross-section is tabulated at specific energies instead of the more usual group representation. The nuclear data are unadjusted in the point form but recently the code has been modified to accept adjusted group data as used in fast and thermal reactor applications. The various geometrical handling capabilities and importance sampling techniques are described. In addition to the nuclear data aspects, the following features are also described; geometrical handling routines, tracking cycles, neutron source and output facilities. 12 references. (auth)

00265 (ANL—75-2, pp 53-66) **Monte Carlo code development in Los Alamos.** Carter, L.L.; Cashwell, E.D.; Everett, C.J.; Forest, C.A.; Schrandt, R.G.; Taylor, W.M.; Thompson, W.L.; Turner, G.D. (Los Alamos Scientific Lab., NM). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

The present status of Monte Carlo code development at Los Alamos Scientific Laboratory is discussed. A brief summary is given of several of the most important neutron, photon, and electron transport codes. 17 references. (auth)

00266 (ANL—75-2, pp 69-74) **Discrete approach to complex planar geometries.** Cupini, E.; De Matteis, A. (Comitato Nazionale Energia Nucleare, Bologna). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

Planar regions in Monte Carlo transport problems have been represented by a finite set of points with a corresponding region index for each. The simulation of particle free-flight reduces then to the simple operations necessary for scanning appropriate grid points to determine whether a region other than the starting one is encountered. When the complexity of the geometry is restricted to only some regions of the assembly examined, a mixed discrete-continuous philosophy may be adopted. By this approach, the lattice of a thermal reactor has been treated, discretizing only the central regions of the cell containing the fuel rods. Excellent agreement with experimental results has been obtained in the computation of cell parameters in the energy range from fission to thermalization through the ^{238}U resonance region. (auth)

00267 (ANL—75-2, pp 75-93) **Organization of cross-section data in the Monte Carlo code SPARTAN.** Bending, R.C. (Central Electricity Generating Board, Berkeley, Eng.). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

The Monte Carlo code SPARTAN is a general-purpose code intended for neutron or gamma transport calculations. The code is designed to accept physics data from a number of external libraries (which may be used singly or in combination) and to use this data with as little alteration as possible. Data obtained from one or several libraries is placed in an interface file on magnetic tape or disk, using a general hierarchical structure which allows particular data items to be assessed in a straightforward way. The interface file, with or without additional data from cards, is regarded as a data source for the main Monte Carlo calculation. A summary of the functional forms, sampling distributions, and particle interaction laws which are available at present, and some of the mathematical methods used are described. 5 references. (auth)

00268 (ANL—75-2, pp 95-118) **Geometry system used in the General Monte Carlo transport code SPARTAN.** Bending, R.C.; Easter, P.G. (Central Electricity Generating Board, Berkeley, Eng.). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

The geometry routines used in the general-purpose, three-dimensional particle transport code SPARTAN are described. The code is designed to deal with the very complex geometries encountered in lattice cell and fuel handling calculations, health physics, and shielding problems. Regions of the system being studied may be represented by simple shapes (spheres, cylinders, and so on) or by multinomial surfaces of any order, and many simple shapes may be combined to make up a complex layout. The geometry routines are designed to allow the program to carry out a number of tasks (such as sampling for a random point or tracking a path through several regions) in any order, so that the use of the routines is not restricted to a particular tracking or scoring method. Routines for reading, checking, and printing the data are included. (auth)

00269 (ANL—75-2, pp 119-130) **Random number generation.** Coveyou, R.R. (Union Carbide Corp., Oak Ridge, TN). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

The subject of random number generation is currently controversial. Differing opinions on this subject seem to stem from implicit or explicit differences in philosophy; in particular, from differing ideas concerning the role of probability in the real world of physical processes, electronic computers, and Monte Carlo calculations. An attempt is made here to reconcile these views. The role of stochastic ideas in mathematical models is discussed. In illustration of these ideas, a mathematical model of the use of random number generators in Monte Carlo calculations is constructed. This model is used to set up criteria for the comparison and evaluation of random number generators. (auth)

00270 (ANL—75-2, pp 133-147) **Bell transform.** Everett, C.J.; Cashwell, E.D. (Los Alamos Scientific Lab., NM). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

The coarse-mesh rebalance method is adopted for Monte Carlo schemes for aiming at accelerating the convergence of a source iteration process. At every completion of the Monte Carlo game for one batch of neutron histories, the scaling factor for the neutron flux is calculated to achieve the neutron balance in each coarse-mesh zone into which the total system is divided. This rebalance factor is multiplied to the weight of each fission source neutron in the coarse-mesh zone for playing the next Monte Carlo game. The numerical examples have shown that the coarse-mesh rebalance Monte Carlo calculation gives a good estimate of the eigenvalue already after several batches with a negligible extra computer time compared to the standard Monte Carlo. 5 references. (auth)

00271 (ANL—75-2, pp 149-159) **Coarse-mesh rebalancing acceleration for eigenvalue problems.** Asaoka, T.; Nakahara, Y.; Miyasaka, S. (Japan Atomic Energy Research Inst., Tokai, Japan). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

The coarse-mesh rebalance method is adopted for Monte Carlo schemes for aiming at accelerating the convergence of a source iteration process. At every completion of the Monte Carlo game for one batch of neutron histories, the scaling factor for the neutron flux is calculated to achieve the neutron balance in each coarse-mesh zone into which the total system is divided. This rebalance factor is multiplied to the weight of each fission source neutron in the coarse-mesh zone for playing the next Monte Carlo game. The numerical examples have shown that the coarse-mesh rebalance Monte Carlo calculation gives a good estimate of the eigenvalue already after several batches with a negligible extra

computer time compared to the standard Monte Carlo. 5 references. (auth)

00272 (ANL—75-2, pp 161-199) **Monte Carlo eigenfunction strategies and uncertainties.** Gast, R.C.; Candelore, N.R. (Bettis Atomic Power Lab., West Mifflin, PA). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

Comparisons of convergence rates for several possible eigenfunction source strategies led to the selection of the "straight" analog of the analytic power method as the source strategy for Monte Carlo eigenfunction calculations. To insure a fair game strategy, the number of histories per iteration increases with increasing iteration number. The estimate of eigenfunction uncertainty is obtained from a modification of a proposal by D. B. MacMillan and involves only estimates of the usual purely statistical component of uncertainty and a serial correlation coefficient of lag one. 14 references. (auth)

00273 (ANL—75-2, pp 201-240) **Monte Carlo work at Argonne National Laboratory.** Gelbard, E.M.; Prael, R.E. 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

A simple model of the Monte Carlo process is described and a (nonlinear) recursion relation between fission sources in successive generations is developed. From the linearized form of these recursion relations, it is possible to derive expressions for the mean square coefficients of error modes in the iterates and for correlation coefficients between fluctuations in successive generations. First-order nonlinear terms in the recursion relation are analyzed. From these nonlinear terms an expression for the bias in the eigenvalue estimator is derived, and prescriptions for measuring the bias are formulated. Plans for the development of the VIM code are reviewed, and the proposed treatment of small sample perturbations in VIM is described. 6 references. (auth)

00274 (ANL—75-2, pp 243-260) **FOCUS: a non-multigroup adjoint Monte Carlo code with improved variance reduction.** Hoogenboom, J.E. (Delft Technological Univ., The Netherlands). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

A description is given of the selection mechanism in the adjoint Monte Carlo code FOCUS in which the energy is treated as a continuous variable. The method of Kalos who introduced the idea of adjoint cross sections is followed to derive a sampling scheme for the adjoint equation solved in FOCUS which is in most aspects analogous to the normal Monte Carlo game. The disadvantages of the use of these adjoint cross sections are removed to some extent by introduction of a new definition for the adjoint cross sections resulting in appreciable variance reduction. At the cost of introducing a weight factor slightly different from unity, the direction and energy are selected in a simple way without the need of two-dimensional probability tables. Finally the handling of geometry and cross section in FOCUS is briefly discussed. 6 references. (auth)

00275 (ANL—75-2, pp 261-279) **Monte Carlo technique for local perturbations in multiplying systems.** Bernnat, W. (Univ., Stuttgart). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

The use of the Monte Carlo method for the calculation of reactivity perturbations in multiplying systems due to changes in geometry or composition requires a correlated sampling technique to make such calculations economical or in the case of very small perturbations even feasible. The technique discussed here is suitable for local perturbations. Very small perturbation regions will be treated by an adjoint mode. The perturbation of the source distribution due to the changed system and its reaction on the reactivity worth or other values of interest is taken into account by a fission matrix method. The formulation of the method and its application are discussed. 10 references. (auth)

00276 (ANL—75-2, pp 281-292) **Bounded estimation of flux-at-a-point for one or more detectors.** Steinberg, H.A. (Mathematical Applications Group, Inc., Elmsford, NY). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

The procedure for biasing the collision density of Monte Carlo particles, so that the estimation of flux at a point detector is bounded, is described. The theory and program design of the solution of the problem of obtaining estimates for several detectors during a single Monte Carlo calculation is presented. 4 references. (auth)

00277 (ANL—75-2, pp 295-313) **Direction-dependent exponential biassing.** Bending, R.C. (Central Electricity Generating Board, Berkeley, Eng.). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

When Monte Carlo methods are applied to penetration problems, the use of variance reduction techniques is essential if realistic computing times are to be achieved. A technique known as direction-dependent exponential biassing is described which is simple to apply and therefore suitable for problems with difficult geometry. The material cross section in any region is multiplied by a factor which depends on the particle direction, so that particles travelling in a preferred direction "see" a smaller cross section than those travelling in the opposite direction. A theoretical study shows that substantial gains may be obtained, and that the choice of biassing parameter is not critical. The method has been implemented alongside other importance sampling techniques in the general Monte Carlo code SPARTAN, and results obtained for simple problems using this code are included. 4 references. (auth)

00278 (ANL—75-2, pp 339-349) **MCT: a Monte Carlo code for time-dependent neutron thermalization problems.** Cupini, E.; Simonini, R. (Comitato Nazionale Energia Nucleare, Bologna). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

In the Monte Carlo simulation of pulse source experiments, the neutron energy spectrum, spatial distribution and total density may be required for a long time after the pulse. If the assemblies are very small, as often occurs in the cases of interest, sophisticated Monte Carlo techniques must be applied which force neutrons to remain in the system during the time interval investigated. In the MCT code a splitting technique has been applied to neutrons exceeding assigned target times, and we have found that this technique compares very favorably with more usual ones, such as the expected leakage probability, giving large gains in computational time and variance. As an example, satisfactory asymptotic thermal spectra with a neutron attenuation of 10^{-5} were quickly obtained. (auth)

00279 (GEAP—14014) **Fondle: a computer code for comparing experimental and analytical data.** Crick, S. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Mar 1975. Contract AT(04-3)-893. 85p. Dep. NTIS $5.45.

The computer code FONDLE was designed and programmed to compare large data arrays and to correlate calculations and experimental results. Using the code one can find the quantitative assessment of an agreement between two sets of results through the determination of uncertainty and bias factors. These factors are determined with least square fitting techniques. Other comparisons that can be performed at the pointwise level are calculating of ratios and finding products or summations of three dimensions arrays. Quantitative comparisons can be made through the use of two-dimensional contour plots or three-dimensional contour plots or three-dimensional perspective view plots. Incorporated into the coding are a number of maintenance options to maneuver arrays into positions of usefulness. That is, arrays can be inverted, unfolded, truncated or rotated into positions where comparisons or calculations can be accomplished. (auth)

00280 **Method of evaluating the precision of cross-spectral density measurements of random noise.** Cohn, C.E. (to U.S. Energy Research and Development Administration). US Patent 3,886,333. 27 May 1975. Filed date 21 Dec 1973. 9p.

PAT-APPL-427,393.

This invention relates to a method of measuring parameters of a nuclear reactor by noise measurements. Noise signals are developed by the detectors placed in the reactor core. The polarity coincidence between the noise signals is used to develop quantities from which various parameters of the reactor can be calculated. (Official Gazette)

COMPONENTS AND ACCESSORIES

00281 (ANL—75-2, pp 315-338) **Monte Carlo methods for shield design calculations.** Grimstone, M.J. (UKAEA, Winfrith, Eng.). 1974.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

Proceedings of the NEACRP meeting of a Monte Carlo study group.

A suite of Monte Carlo codes is being developed for use on a routine basis in commercial reactor shield design. The methods adopted for this purpose include the modular construction of codes, simplified geometries, automatic variance reduction techniques, continuous energy treatment of cross section data, and albedo methods for streaming. Descriptions are given of the implementation of these methods and of their use in practical calculations. 26 references. (auth)

00282 (BNL—19768) **Elastic and inelastic methods of piping systems analysis: a preliminary review.** Reich, M.; Esztergar, E.P.; Spence, J.; Boyle, J.; Chang, T.Y. (Brookhaven National Lab., Upton, N.Y. (USA)). Feb 1975. 71p. Dep. NTIS $6.75.

A preliminary review of the methods used for elastic and inelastic piping system analysis is presented. The following principal conclusions are reached: techniques for the analysis of complex piping systems operating in the high temperature creep regime should be further developed; accurate analysis of a complete pipework system in creep using the "complete shell finite element methods" is not feasible at the present, and the "reduced shell finite element method" still requires excessive computer time and also requires further investigation regarding the compatibility problems associated with the pipe bend element, particularly when applied to cases involving general loading conditions; and with the current size of proposed high temperature systems requiring the evaluation of long-term operating life (30 to 40 years), it is important to adopt a simplified analysis method. A design procedure for a simplified analysis method based on currently available techniques applied in a three-stage approach is outlined. The work required for implementation of these procedures together with desirable future developments are also briefly discussed. Other proposed simplified approximations also are reviewed in the text. 101 references. (auth)

00283 (CONF-740301—5) **Friction and wear in sodium.** Hoffman, N.J.; Droher, J.J. (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 1973. Contract AT(04-3)700. 29p. Dep. NTIS $4.50.

From NACE meeting - corrosion;74; Chicago, Illinois, USA (4 Mar 1974).

In the design of a safe and reliable sodium-cooled reactor one of the more important problem areas is that of friction and wear of components immersed in liquid sodium or exposed to sodium vapor. Sodium coolant at elevated temperatures may severely affect most oxide-bearing surface layers which provide corrosion resistance and, to some extent, lubrication and surface hardness. Consequently, accelerated deterioration may be experienced on engaged-motion contact surfaces, which could result in unexpected reactor shutdown from component malfunction or failure due to galling and seizure. An overall view of the friction and wear phenomena encountered during oscillatory rubbing of surfaces in high-temperature, liquid-sodium environments is presented. Specific data generated at the Liquid Metal Engineering Center (LMEC) on this subject is also presented. (auth)

00284 (HEDL-TME—75-10) **Heavy section steel technology program. Technical report No. 36. The irradiated fracture toughness of ASTM A533, Grade B, Class 1 steel measured with a four inch thick compact tension specimen.** Williams, J.A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jan 1975. Contract AT(45-1)-2170. 30p. Dep. NTIS $4.00.

The fracture toughness of an ASTM A533-B four inch thick compact tension specimen irradiated to approximately 3.8 x 10^{19} n/cm^2 (E greater than 1 MeV) at 550°F was determined to be 80 ksi $\sqrt{in}$ at a test temperature of 200°F. Smaller 0.394 inch thick fracture specimens were tested prior to the large specimen test to aid in establishing the test temperature and to compare the fracture transition of large and small irradiated specimens. The K/sub Ic.394/ toughness transition as measured at 100 ksi $\sqrt{in}$ was observed at a temperature of 210°F; plate RW and WR orientations were comparable. Fracture toughness behavior of the small specimens closely predicts the large specimen behavior in the transition region. 23 references. (auth)

00285 **Impact of inservice inspection on the reliability of pressure vessels and piping.** Bush, S.H. (Battelle-Northwest, Richland, WA). pp 1-13 of **Reliability engineering in pressure vessels and piping.** Gangadharan, A.C. (ed.). New York; American Society of Mechanical Engineers (1975).

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

See CONF-750617—18.

The reliability of pressure components of a nuclear reactor is a function of the as-fabricated quality plus a program of continuing inspection during operation. Since insufficient data exist to quantitatively determine failure probabilities of nuclear pressure vessels and piping, it is necessary to utilize information from comparable non-nuclear systems such as power boilers. Based on probabilistic studies it is inferred that in-service inspection improves component reliability one-to-two orders of magnitude depending on the type and completeness of the inspections. An attempt is made to assess the significance of the ASME Section XI Code as to relative completeness of inspection and the probable improvement in reliability. (auth)

00286 **Room temperature elastic-plastic response of thin-walled tubes subjected to nonradial combinations of axial and torsional loadings.** Liu, K.C. (Oak Ridge National Lab., TN). pp 1-12 of **Pressure vessels and piping: verification and qualification of inelastic analysis computer programs.** Corum, J.M.; Wright, W.B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

See CONF-750617—16.

Two tubular specimens of Type 304 stainless steel with uniform thin walls were subjected to a program of segmental combined tension/compression and torsion loadings at room temperature. A proportional, or radial, loading into the plastic range was initially applied to each specimen. Two nonproportional (nonradial) loadings along straight-line segments for which neither the loading paths nor their linear extrapolations passed through the origin of the stress space were then applied. The axial and torsional stress-strain curves for these segmental prestress loadings are presented. Hence, the stress-strain response characteristics for nonproportional loading as well as for proportional loading can be studied. In addition, the axial and torsional plastic strain components were calculated, and the total plastic strain trajectories are plotted in a plastic strain space. Finally, using results from a detailed study of yield surfaces, which was performed for the first specimen, a spectrum of initial and subsequent yield curves corresponding to the segmental prestress loadings is presented. (auth)

00287 **Elevated-temperature tests of simply-supported beams and circular plates subjected to time-varying loadings.** Corum, J.M.; Richardson, M. (Oak Ridge National Lab., TN). pp 13-25 of **Pressure vessels and piping: verification and qualification of inelastic analysis computer programs.** Corum, J.M.; Wright, W.B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

See CONF-750617—16.

The measured elastic-plastic and elastic-plastic-creep responses of a number of simply-supported Type 304 stainless steel beams and circular plates are presented. Beams and plates exhibit the essential features of inelastic structural behavior; yet they are relatively simple. In beams, the stress fields are largely uniaxial, while multiaxial effects are introduced in plates. The specimens were laterally loaded at the center, and the tests were performed by subjecting the specimens to either a prescribed load or center-deflection history. The specimens were machined from a common, well-characterized heat of material, and all of the tests were performed at a temperature of 1100°F. The elastic-plastic tests consisted of short-time cycling of the center load, or deflection, between fixed limits. In the elastic-plastic-creep tests the center load, or deflection, was held constant for periods of time, but was periodically subjected to a step increase or decrease, including reversals. The test results are presented in terms of the load and center-deflection behaviors, which typify the overall structural behavior. (auth)

00288 **Residual strains in a stainless steel plate with a circular hole and subjected to reverse loading at elevated temperature.** Durelli, A.J.; Buitrago, J. (Catholic Univ. of America, Washington, DC). pp 27-37 of **Pressure vessels and piping: verification and qualification of inelastic analysis computer programs.** Corum, J.M.; Wright, W.B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

See CONF-750617—16.

A description is given of studies directed at the determination of strains in a stainless steel plate with a circular hole and subjected to a temperature of 1100°F and to a successively applied

tensile and compressive in-plane loading sufficiently large to produce plastic strains and creep. The duration of this test was 1000 hours. Square grids of lines (at a distance of 0.25 in.) and crossed-gratings (500 lines/in.) were engraved on both surfaces of the plate before the test. After the plate was unloaded and brought back to room temperature the grids were analyzed using traveling microscopes, and the gratings using the moire effect. Both Cartesian strains were determined from the moire isothetics along the axes of the plate, along the two lines tangent to the hole and parallel to those axes, and along the edges of the plate. Grid measurements were also made at specific points, and the deformed shapes of the hole and of the plate were determined. It is estimated that strains larger than 0.001 can be determined with the techniques and methods used. (auth)

00289 **Elevated-temperature-elastic-plastic-creep test of a shear-lag panel.** Egger, R.L. (Boeing Aerospace Co., Seattle). pp 29-45 of **Pressure vessels and piping: verification and qualification of inelastic analysis computer programs.** Corum, J.M.; Wright, W.B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

See CONF-750617—16.

A description is given of a test program to provide elastic-plastic-creep structural test data for comparison with inelastic analysis predictions, and to demonstrate the capabilities of high-temperature capacitive strain gages as long-term stable strain-measuring devices. The test specimen used was a shear-lag structure consisting of a thin, square, stainless-steel plate loaded in its plane through tapered stiffeners. A shear-lag specimen was instrumented with ten capacitive strain gages, heated to 1100°F and subjected to long-term tensile and compressive loads. Capacitive strain gage data from the long-term test are presented and discussed. (auth)

00290 **Tests at room temperature and 1100 F on a 4-in. sch. 10 elbow-pipe assembly subjected to in-plane moment loading.** Griffith, W.I.; Rodabaugh, E.C. (Battelle's Columbus Labs., OH). pp 59-78 of **Pressure vessels and piping: verification and qualification of inelastic analysis computer programs.** Corum, J.M.; Wright, W.B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

See CONF-750617—16.

A 4-in. Sch. 10 Type 304 stainless steel elbow was welded to pipe legs and subjected to an in-plane moment loading at room temperature and at 1100°F. Loads were applied by weights. Displacements and strains were measured. The results are presented and discussed in relationship to relatively simple theories for elastic and plastic/creep behavior of elbows. (auth)

00291 **Comparison of typical inelastic analysis predictions with benchmark problem experimental results.** Clinard, J.A.; Corum, J.M.; Sartory, W.K. (Oak Ridge National Lab., TN). pp 79-98 of **Pressure vessels and piping: verification and qualification of inelastic analysis computer programs.** Corum, J.M.; Wright, W.B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

See CONF-750617—16.

The results of exemplary inelastic analyses are presented for a series of experimental benchmark problems. Consistent analytical procedures and constitutive relations were used in each of the analyses, and published material behavior data were used in all cases. Two finite-element inelastic computer programs were employed. These programs implement the analysis procedures and constitutive equations for Type 304 stainless steel that are currently used in many analyses of elevated-temperature nuclear reactor system components. The analysis procedures and constitutive relations are briefly discussed, and representative analytical results are presented and compared to the test data. The results that are presented demonstrate the feasibility of performing inelastic analyses, and they are indicative of the general level of agreement that the analyst might expect when using conventional inelastic analysis procedures. (auth)

00292 **Appendix, material property data for elastic-plastic-creep analyses of benchmark problems.** Corum, J.M. (Oak Ridge National Lab., TN). pp 99-109 of **Pressure vessels and piping: verification and qualification of inelastic analysis computer programs.** Corum, J.M.; Wright, W.B. (eds.). New York; American Society of Mechanical Engineers (1975).

From 2. ASME national congress on pressure vessels and piping; San Francisco, California, USA (24 Jun 1975).

See CONF-750617—16.

A summary of applicable stainless steel-304 material property data is presented which is required as input to conventional elastic-plastic and elastic-plastic-creep analyses. The data include elastic constants and a monotonic stress-strain curve at room temperature, elastic constants, cyclic stress-strain curve, physical properties for the 800 to 1100°F temperature range, and uniaxial, constant-stress creep data for a temperature of 1100°F. (auth)

FUEL ELEMENTS

00293 (HEDL-SA—757) **Neutron radiography of fuel pins.** Jackson, C.N. Jr.; Powers, H.G.; Burgess, C.A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. 45p. (CONF-750235—1). Dep. NTIS $5.25.

From Symposium on practical applications of neutron radiography and gauging; Gaithersburg, Maryland, USA (10 Feb 1975).

Neutron radiography performed with a reactor source has been shown to be a superior radiographic method for the examination of unirradiated mixed oxide fuel pins at the Hanford Engineering Development Laboratory. Approximately 1,700 fuel pins were contained in a sample that demonstrated the capability of the method for detecting laminations, structural flaws, fissile density variation, hydrogenous inclusions and voids in assembled fuel pins. The nature, extent, and importance of the detected conditions are substantiated by gamma autoradiography and by destructive analysis employing alpha autoradiography, electron microprobe and visual inspection. Also, a series of radiographs illustrate the response of neutron radiography as compared to low voltage and high voltage x-ray and gamma source Iridium 192 radiography. (auth)

00294 (LA—6011-MS) **Analysis of fuel-bundle radiographs using modeling.** Demuth, H.B. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. Contract W-7405-ENG-36. 26p. Dep. NTIS $4.00.

It was desired to estimate the thickness of gaps imaged on highly degraded radiographs. A powerful mathematical method for estimating gap widths was developed and applied. The problem, the techniques used to solve the problem, and results, conclusions, and suggestions for future work are presented. (auth)

00295 (ORO—4212-16) **Quantitative determination of the structure-property relationships in nuclear fuel element materials. Final report, June 1969—July 1973.** Rhines, F.N.; DeHoff, R.T.; Whitney, E.D. (Florida Univ., Gainesville (USA). Engineering and Industrial Experiment Station). May 1975. Contract AT(40-1)-4212. 255p. Dep. NTIS $15.75.

New developments in quantitative microscopy are first described. The use of the described techniques to quantitatively characterize the microstructural states of nickel and uranium dioxide samples is then discussed. The determination of gas permeability, thermal conductivity, mechanical properties, and creep behavior in the characterized samples are also described. (JWR)

00296 **Suspension scheme for fuel pin.** Butts, C.E.; Gray, H.C. (to U.S. Energy Research and Development Administration). US Patent 3,890,197. 17 Jun 1975. Filed date 29 May 1961. 8p.

PAT-APPL-113,566.

A description is presented of a nuclear fuel pin suspension arrangement comprising, in combination, a rod; a first beam member connected to said rod at one end; a plurality of parallel-spaced slidable fuel support plates attached to said first beam member, the longitudinal axis of first beam member being perpendicular to the longitudinal axis of each of said fuel support plates, a first coupling means disposed along the length of the first beam member for permitting slidable fuel support plates parallel movement with respect to the longitudinal axis of said first beam member, a second coupling means located at one end of each of slidable fuel plates for slidably engaging first coupling means of first beam member, a second beam member connected to the other end of each of parallel-spaced slidable fuel support plates and providing an extension, second beam member being provided with a third coupling means disposed along the length of second beam member at one end thereof; and a plurality of fuel pins provided with a fourth coupling means located at one end of each fuel pin for slidably engaging third coupling means of second beam member to permit each fuel pin parallel movement with respect to the longitudinal axis of second beam member. (Official Gazette)

ENVIRONMENTAL ASPECTS

00297 (ORNL-TM—4985) **Lists of environmental statements projects.** Buskirk, B.A.; Spiewak, A.R. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 44p. Dep. NTIS $5.25.

The document is a collection of five lists of the Environmental Statements Projects related to nuclear power reactors, consumer products in which by-product radionuclides may be used, ERDA facilities, and, for the Department of Housing and Urban Development, Modular Integrated Utilities Systems. The lists are arranged by (1) Project name, (2) Project docket number, (3) NRC Environmental Project Manager, (4) ORNL Task Group Leader, and (5) ORNL editor. In each list, the first issue date listed for each project is the issue date of its Draft Environmental Statement (DES), and the second issue date is that of the Final Environmental Statement (FES). The lists will be updated as the Environmental Statements Project continues. (auth)

SITING

00298 (STI/PUB—384) **Siting of nuclear facilities. Proceedings of a symposium held in Vienna, 9—13 December 1974. Proceedings series.** (International Atomic Energy Agency, Vienna (Austria)). 1975. 677p. (In several languages). (CONF-741210—). IAEA $39.00.

From Symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974).

Thirty-eight papers are presented under the following topic headings: national siting criteria and practices, siting and environment, siting and reprocessing plants, and new approaches to siting policies. Separate abstracts were prepared for all papers. (DG)

00299 **Experience in assessing acceptability of nuclear sites selected by the utility industry in the USA: 1971—1974.** Gustafson, P.F. (Argonne National Lab., IL). pp 219-226 of **Siting of nuclear facilities.** Vienna; International Atomic Energy Agency (1975).

From Symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974).

See STI/PUB—384; CONF-741210—.

Considerable first-hand experience has been accumulated during the past decade in the USA on selection of suitable sites for nuclear facilities. Since 1970, the National Environmental Policy Act has required that consideration be given to potential adverse environmental impacts. Safety remains the foremost factor in site acceptability, followed by environmental considerations, and, although not a formal requirement, socio-economic issues are also considered in site evaluation. The prime safety issues are public health and safety under routine operating conditions and under all conceivable accident conditions. The constraint against siting nuclear facilities in or near heavily populated areas minimizes the problem of public safety. Siting in regions where the probability of natural events such as earthquakes, tidal waves or floods must be avoided. The methodology for site acceptance from an environmental standpoint is still in a developmental stage. The objective is now to reduce the probable environmental impact due to construction and operation of nuclear facilities. Reduction may be accomplished in a number of ways, the most extreme being the use of another site. Less severe changes may involve one or more of the following: primary cooling system, water intake and discharge design, radwaste and chemical waste systems, and transmission-line routing. Early site selection on a regional basis is also being considered. (auth)

00300 **Quantified social and aesthetic values in environmental decision making.** Burnham, J.B. (Battelle Pacific Northwest Labs., Richland, Wash.); Maynard, W.S.; Jones, G.R. pp 307-326 of **Siting of nuclear facilities.** Vienna; International Atomic Energy Agency (1975).

From Symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974).

See STI/PUB—384; CONF-741210—.

A method has been devised for quantifying the social criteria to be considered when selecting a nuclear design and/or site option. Community judgement of social values is measured directly and indirectly on eight siting factors. These same criteria are independently analyzed by experts using techno-economic methods. The combination of societal and technical indices yields a weighted score for each alternative. The aesthetic impact was selected as the first to be quantified. A visual quality index was developed to measure the change in the visual quality of a viewscape caused by construction of a facility. Visual quality was measured by reducing it to its component parts—intactness, vividness and unity—and rating each part with and without the facility. Urban planners and landscape architects used the technique to analyze three viewscapes, testing three different methods on each viewscape. The three methods used the same aesthetic elements but varied in detail and depth. The technique with the greatest analytical detail was the most reliable method. Social value judgements were measured by social psychologists applying a questionnaire technique, using a number of design and site options to illustrate the range of criteria. Three groups of predictably different respondents—environmentalists, high-school students and businessmen—were selected. The three groups' response patterns were remarkably similar, though businessmen were consistently more biased towards nuclear power than were environmentalists. (auth)

00301 **Underground siting of nuclear power reactors.** Karpenko, V.N.; Walter, C.E. (Univ. of California, Livermore). pp 581-595 of **Siting of nuclear facilities.** Vienna; International Atomic Energy Agency (1975).

From Symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974).

See STI/PUB—384; CONF-741210—.

A preliminary study of reactor siting has evolved a new concept of undergrounding that calls for excavation of an open pit. The reactor containment structure can be built using conventional construction techniques. After construction, the reactor vessel is covered with backfill material of defined permeability and porosity. Calculations show that because of this controlled permeability, radioactive seepage is confined in the backfill should an accident rupture the containment structure. The required depth of burial for complete confinement of the radioactive release is on the order of 100 m. Even a few meters of selected backfill, however, provide a dramatic reduction in the consequences of a transient release of radioactivity due to filtration and adsorption. In addition, backfill makes the reactor invulnerable to tornadoes and falling objects. Solving the containment issue in this economic manner makes close-in, metropolitan reactor siting a distinct possibility. (auth)

RADIOACTIVE EFFLUENTS

00302 **Radioactive effluent releases and the public acceptance of nuclear facility sites.** Hull, A.P. (Brookhaven National Lab., Upton, NY). pp 247-263 of **Siting of nuclear facilities.** Vienna; International Atomic Energy Agency (1975).

From Symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974).

See STI/PUB—384; CONF-741210—.

A public controversy about the risks from radioactivity in effluents from nuclear power plants in the United States of America arose in the late 1960s, as their utilization was growing towards large-scale commercial basis. Several scientific critics alleged variously that the existing plants had occasioned excess infant mortality in their vicinities and that the growth of nuclear power would produce large increases in the cancer death rate in the general population. The controversy caused by these allegations led to the Biological Effects of Ionizing Radiation Committee's review of the effects of exposure to low levels of ionizing radiation. It also appeared to underlie the USAEC's "Appendix I" proposals for numerical design limits for nuclear power plant effluents. These proposals are intended to limit the dose of any nearby individual to 5 mR/a. A critical assessment is presented which indicates that the critics' allegations were either without substance or irrelevant. Using effluent release data from recent years, the population health risk from power-reactor effluent radiation exposures appears to be far smaller than that from fossil-fuelled plant effluents, as well as within the range of those otherwise considered as negligible. Such comparisons are suggested as more hopeful towards achieving public acceptance than "as low as practicable" measures, which serve to exaggerate the risks of radiation. (auth)

RESEARCH, TEST, EXPERIMENTAL, ZERO-POWER, AND TRAINING REACTORS AND SUBCRITICAL ASSEMBLIES

00303 (ANL-CT—75-36) **Analytical and experimental study of two concentric cylinders coupled by a fluid gap.** Mulcahy, T.M.; Turula, P.; Chung, H.; Jendrzejczyk, J.A. (Argonne National Lab., Ill. (USA)). Apr 1975. 17p. (CONF-750908—3). Dep. NTIS $4.00.

From 3. international conference on structural mechanics in reactor technology; London, UK (1 Sep 1975).

A breeder reactor vessel is a substantial steel cylinder which is partially protected from the nuclear reaction temperature by a relatively thin concentric shell separated from the vessel by a narrow fluid-filled gap. An experimental and analytical study of the vibration of a model of such a shell used in the Fast Test Reactor is described. The analytical work consists first using a free vibration solution of the shell in vacuum as a basis for extrapolating

vibration behavior for the same shell with a fluid gap. Then a direct finite element solution is found for the actual problem—the shell and the fluid coupling it to the rigid outer container. All the finite element computations were carried out using the NASTRAN program. The experimental setup consisted of a steel sheet rolled and welded into a cylinder, free at the top edge and at the bottom soldered to a disc which in turn was bolted to a heavy base plate. The fluid gap was provided by using a thick concrete shell as the outer cylinder. A series of these cylinders was used to provide several sizes of annular gap. The case of the steel shell alone, without fluid, was also considered. The steel cylinder was vibrated by an electromagnetic exciter using both harmonic loading and random loading functions. In general, correspondence of experimental and analytical results is within acceptable limits; however, several vibration modes corresponding to solutions with low circumferential wave numbers were not detected experimentally. Response analysis performed to compare the response amplitude at various modes indicates that the intensity at the modes in question is very low. (auth)

00304 (CONF-750804—6) **Natural circulation cooling of FFTF closed loop test sections during removal from reactor.** Coffield, R.D.; Miller, J.V. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Oct 1974. Contract AT(45-1)-2171. 16p. Dep. NTIS $4.00.

From Conference on heat transfer; San Francisco, California, USA (11 Aug 1975).

Analytical results and experimental data on the natural convection cooling of FFTF fuel assemblies during removal from the reactor are compared. (JWR)

00305 (DP—1367) **Method of analysis to determine subcritical reactivity from the pulsed neutron experiment.** Parks, P.B. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jun 1975. Contract AT(07-2)-1. 43p. Dep. NTIS $4.00.

The published methods for the deduction of reactivity from pulsed neutron experiments on subcritical reactors are reviewed. Each method is categorized as inherently yielding a result that is either spatially independent or spatially dependent. The spatially independent results are formally identical with the static reactivity; the result does not depend, in principle, on the location of either the pulsed neutron source or the neutron detector during data collection. The spatially dependent results only approximate the static reactivity; the results are affected, in varying degrees, by the locations of the source and detector. Among the techniques yielding spatially independent results are the Space-Time method of Parks and Stewart and the Inhour method of Preskitt et al. Spatially dependent results are obtained with the Sjoestrand, Gozani, and Garelis-Russell methods which are examined with and without the kinetic distortion corrections given by Becker and Quisenberry. Intercomparisons of all methods are made with reference to pulsed neutron experiments on both unreflected and reflected reactors. Recommendations are made concerning the best choice of method under the various experimental conditions that are likely to be encountered. 14 references. (auth)

00306 (DP-MS—75-61) **Decommissioning plan for the Heavy Water Components Test Reactor.** Field, F.R. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 23p. (CONF-750822—3). Dep. NTIS $4.25.

From 14. international conference on low temperature physics; Otaniemi, Finland (14 Aug 1975).

Three alternatives to decommission the Heavy Water Components Test Reactor (HWCTR) have been analyzed. No final choice has been made between alternatives, and all are feasible. Selection of a plan for decommissioning will depend on criteria that are presently being formulated within ERDA and other regulatory bodies. (auth)

00307 (HEDL-SA—680) **Specifying and manufacturing piping for the fast flux test facility.** Moen, R.A.; O'Keefe, D.P.; Irvin, J.E.; Tobin, J.C. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 19 Apr 1974. Contract AT(45-1)2170. 25p. (CONF-740606—21). Dep. NTIS $4.25.

From Pressure vessels and piping-materials-nuclear conference; Miami Beach, Florida, USA (24 Jun 1974).

Specification of materials for liquid metal reactor coolant piping, at service temperatures up to 1200°F, involves a number of considerations unique to these systems. The mechanical property/design allowable stress considerations which led to the selection and specification of specific materials for the Fast Flux Test Facility piping are discussed. Additional considerations are described indicating allowances made for material changes anticipated in service. These measures primarily involved raising the minimum carbon content to a value that would insure the strength of the material always remains above that assumed in the initial design, although other considerations are discussed. The processes by which this piping was manufactured, its resulting characteristics and methods of subsequent handling/assembly are briefly discussed. (auth)

00308 (HEDL-SA—915) **FFTF constructibility.** Weber, S.A.; Hulbert, D.I. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 25 Mar 1975. Contract AT((45-1)-2170. 22p. (CONF-750604—2). Dep. NTIS $4.25.

From US;USSR seminar on fast breeder reactor construction and experience; Obinsk, USSR (2 Jun 1975).

The influence of the design criteria on the constructibility of the Fast Flux Test Facility is described. Specifically, the effects of requirements due to maintenance accessibility, inerting of cells, seismicity, codes, and standards are addressed. The design and construction techniques developed to minimize the impact of the design criteria on cost and schedule are presented with particular emphasis on the cleanliness and humidity controls imposed during construction of the sodium systems. (auth)

00309 (HEDL-SA—916) **Testing experience with fast flux test facility.** Noordhoff, B.H.; McGough, C.B.; Nolan, J.E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 24 Mar 1975. Contract AT(45-1)-2171. 21p. (CONF-750604—3). Dep. NTIS $4.25.

From US;USSR seminar on fast breeder reactor construction and experience; Obinsk, USSR (2 Jun 1975).

Early FFTF project planning emphasized partial and full-scale testing of major reactor and plant prototype components under expected environmental conditions, excluding radiation fields. Confirmation of component performance during FFTF service was considered essential before actual FFTF startup, to provide increased assurance against FFTF startup delays or operational difficulties and downtime. Several new sodium facilities were constructed, and confirmation tests on the prototype components are now in progress. Test conditions and results to date are reported for the primary pump, intermediate heat exchanger, sodium-to-air dump heat exchanger, large and small sodium valves, purification cold trap, in-vessel handling machine, instrument tree, core restraint, control rod system, low-level flux monitor, closed loop ex-vessel machine, refueling equipment, and selected maintenance equipment. The significance and contribution of these tests to the FFTF and Liquid Metal Fast Breeder Reactor (LMFBR) program are summarized. (auth)

00310 (HEDL-SA—933) **FFTF fuel pin design bases and performance.** Cox, C.M.; Hanson, J.E.; Roake, W.E.; Slember, R.J.; Weber, C.E.; Millunzi, A.C. (Hanford Engineering Development Lab., Richland, Wash. (USA); Energy Research and Development Administration, Washington, D.C. (USA)). Apr 1975. Contract AT(45-1)2170. 35p. (CONF-750411—9). Dep. NTIS $4.75.

From European nuclear conference; Paris, France (21 Apr 1975).

The FFTF fuel pin was conservatively designed to meet thermal and structural performance requirements in the categories normal operation, upset events, emergency events, and hypothetical, faulted events. The fuel pin operating limits consistent with these requirements were developed from a strong fuel pin irradiation testing program scoped to define the performance capability under relevant steady state and transient conditions. Comparison of the results of the irradiation testing program with design requirements indicates that the FFTF fuel pin can exceed its goal burnup of 80,000 MWd/MTM. (auth)

00311 (HEDL-SA—934) **FFTF: Rosetta Stone of the U.S. Breeder Reactor Program.** McGough, C.B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 17 Apr 1975. 44p. (CONF-750464—1). Dep. NTIS $5.25.

From Joint meeting of ASME and AIEEE Hawaii sections; Honolulu, Hawaii, USA (17 Apr 1975).

Design specifications for FFTF components are presented. Reactor operating parameters are included. 9 references. (DCC)

00312 (HEDL-TME—75-52) **Central fuel worth in the Fast Test Reactor (FTR) engineering mockup.** Dobbin, K.D.; Daughtry, J.W. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1975. Contract AT(45-1)-2170. 27p. AT.

The reactivity change associated with the movement of fuel along the axial centerline of the FTR engineering mockup was computed. A detailed three-dimensional model using the diffusion theory code, 3DB, was used to compute the total reactivity worth, and a two-dimensional R-Z model using the diffusion theory code, 2DB, was used to compute the axial worth profile. Twelve energy groups were used in both sets of calculations. Comparison of the results with experimental data provided calculation to experiment (C/E) bias factors which can be applied to the calculation of the central fuel worth in the FTR. 13 references. (auth)

00313 (HEDL-TME—75-79) **Method for determining detailed rod worth profiles at low power in the fast test reactor.** Sevenich, R.A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract AT(45-1)-2170. 51p. Dep. NTIS $5.75.

A method for obtaining a detailed rod worth profile at low power for a slow control rod insertion is presented. The accuracy of the method depends on a preparatory experiment in which the test rod is dropped quickly to yield, upon analysis, the magnitude of the rod worth and an effective source value. These numbers are employed to initialize the inverse kinetics analysis for the slow insertion. Corrections for changes in detection efficiency are not included for the simulated experiments. (auth)

00314 (LA—5963) **Reflector-moderated critical assemblies.** Paxton, H.C.; Jarvis, G.A.; Byers, C.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. Contract W-7405-ENG-36. 11p. Dep. NTIS $4.00.

Experiments with reflector-moderated critical assemblies were part of the Rover Program at the Los Alamos Scientific Laboratory (LASL). These assemblies were characterized by thick D_2O or beryllium reflectors surrounding large cavities that contained highly enriched uranium at low average densities. Because interest in this type of system has been revived by LASL Plasma Cavity Assembly studies, more detailed descriptions of the early assemblies than had been available in the unclassified literature are provided. (auth)

00315 (LA-UR—75-956) **Temperature control with high performance gravity-assist heat pipes.** Kemme, J.E.; Deverall, J.E.; Keddy, E.S.; Phillips, J.R.; Ranken, W.A. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 6p. Dep. NTIS $4.00.

The development of high performance heat pipes for controlling the temperature of irradiation experiments in the Experimental Breeder Reactor (EBR-II) is described. Because this application involves vertical operation in a gravity-assist mode with the evaporator down, several tests were made with sodium and potassium heat pipes in this position to establish their performance limits as a function of operating temperature. Best performance was achieved with a new wick structure consisting of a fine porous liner next to the heat-pipe wall and four helical channels next to the vapor passage. Also, a new modification of heat-pipe theory was discovered for determining performance limits for this type of wick. In its most rudimentary form, this modification says that the dynamic pressure gradient in the vapor stream cannot exceed the gravity gradient causing return of liquid. Once this modification was expressed in the form of a limiting equation, and a term was added to account for the slight capillary force developed in the channels, good agreement was obtained between calculated limits and those measured in several tests with both sodium and potassium. These tests showed rather conclusively that only half of the liquid head in the evaporator section was causing return of condensate, whereas existing theory predicts that the full head of liquid in the heat pipe is available for condensate return. (auth)

00316 (ORNL-TM—4283) **ORNL TSF pipe chase neutron streaming experiment, phase 2.** McGregor, B.J.; Clifford, C.E.; Muckenthaler, F.J.; Mynatt, F.R. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 51p. AT.

A second ORNL Tower Shielding Facility experiment has been performed and analyzed in the investigation of techniques for predicting the extent of neutron streaming through the sodium coolant pipes of the Fast Flux Test Facility (FFTF). In this second experiment the HTS pipeway of the FFTF was mocked up by a concrete-walled plenum (18 ft by 13.7 ft by 57.5 in.) lined with steel. A beam of reactor neutrons entered through one of the large walls and scattered throughout the plenum. A fraction of the scattered neutrons then entered a 31-in.-diam pipe-chase mockup located near one end of the plenum in the large wall on which the beam was incident. Measurements of neutron intensities were made with Bonner ball detectors along horizontal and vertical traverses within the plenum, and neutron spectra were measured with a Benjamin spectrometer at two locations within the plenum. Bonner ball measurements were also made along the axis of the empty pipe chase and along radial traverses beyond the empty pipe chase outside the plenum. Additional measurements were made beyond the pipe chase containing first a 16-in.-OD sodium-filled pipe and then the pipe surrounded by insulation. 9 references. (auth)

00317 (ORNL-TM—4963) **Bearings for the HFIR control plates.** Abbatiello, A.A. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 30p. Dep. NTIS $4.50.

Recent accelerated wear of HFIR bearings seems to be a more advanced stage of the situation encountered in 1967. The latest observations are in agreement with the hypothesis that high-frequency impact loads at a 30° angle on these bearings are the apparent basic cause of their short life. In view of the limited possibilities for change at this stage of HFIR operation, the region of best payoff seems to be an increase in the load-carrying area at some acceptable sacrifice of low rolling friction. On this basis three types of bearings are proposed for test—two of these are journal types and one is a slider type. The next planned shutdown for major parts replacement provides an opportunity to test these modified bearing types in the HFIR under full mechanical operating conditions but without nuclear operation. The program is recommended for consideration and adoption. (auth)

PLUTONIUM AND ISOTOPE PRODUCTION, CHEMONUCLEAR, MATERIALS TESTING, AND MATERIALS PROCESSING REACTORS

00318 (DP-MS—74-66) **Spray cooling of heated cylinders.** Harris, S.D. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. 24p. (CONF-750804—2). Dep. NTIS $4.25.

From Conference on heat transfer; San Francisco, California, USA (11 Aug 1975).

Heat transfer from heated horizontal cylinders cooled by a water spray was determined to aid evaluation of a spray cooling system for emergency cooling of irradiated nuclear fuel discharged in air from a reactor. In steady state tests, a test cylinder was cooled with a known steady spray as the heat generation rate was increased in steps; metal temperatures were recorded when steady state was reached. From these measurements, overall heat transfer coefficients were determined as functions of cylinder surface temperature, spray water temperature, spray density, and cylinder diameter. In transient tests, a test section was heated at constant power to various initial surface temperatures before cooling by the water spray. The results indicate the Leidenfrost point is a reliable guide to the ability of the spray system to arrest the temperature rise. 5 references. (auth)

00319 (DUN—6664) **K through reactor decontamination engineering report.** Brinkman, L.B. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 21 Jan 1970. Contract AT(45-1)-1857. 7p. Dep. NTIS $4.00.

The basic engineering requirements for a through-reactor decontamination system at one of the K reactors are presented. (JWR)

00320 (DUN—7593) **Radiological status report deactivation of the 105-B reactor plant.** Westover, W.G. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 12 Apr 1971. 15p. Dep. NTIS $4.00.

The radiological status of deactivated buildings in 100-B Area associated with operation of 105-B is described providing a record for use in post-deactivation surveillance and salvage of material and equipment. It does not include surveys or conditions outside the concerned buildings. (auth)

00321 (DUN—7630) **Radiological status report deactivation of the 105-KW reactor plant.** (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 26 Apr 1971. 14p. Dep. NTIS $4.00.

The 105-kW Reactor building and associated facilities were cleaned as necessary for long-range contamination and radiation control. Where complete release from radiation zone status was not practical, radiation zone posting was accomplished. Zones of significant contamination or radiation potential, including the Discharge Area, the Inner Rod Room, and the Ball 3X Tunnel, were barricaded to prevent inadvertent uncontrolled personnel entry. (auth)

00322 (DUN—7636) **Radiological status report. Deactivation of the 105-KE reactor plant.** Westover, W.G. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 30 Apr 1971. 18p. Dep. NTIS $4.00.

The radiological status of deactivated buildings in 100-K Area associated with operation of 105-KE as of April 15, 1971 is described providing a record for use in post-deactivation surveillance and salvage of material and equipment. It does not include surveys or conditions outside the concerned buildings. (auth)

00323 **Development of high-performance uranium-metal fuels for Savannah River reactors.** McDonnell, W.R.; Sturcken, E.F. (E.I. du Pont de Nemours and Co., Aiken, SC). *Nucl. Technol.*; **26**: No. 4, 420-429(Aug 1975).

The development of high-performance uranium-metal fuel elements for Savannah River reactors required a major metallurgical effort to achieve satisfactory irradiation behavior. Fuel-element design changes, principally embodying increased heat-transfer area,

were accompanied by improved methods for bonding the uranium cores within aluminum cans. Anisotropic growth of the fuel element during irradiation caused by texture of the core was eliminated by development of beta heat-treating processes using oil quenching. Cavitational swelling was controlled by minor alloying additions to the uranium metal. The resulting fuel elements proved capable of sustaining high exposures. 18 references. (auth)

PROPULSION REACTORS

00324 (LA—5931) **Review of fuel element development for nuclear rocket engines.** Taub, J.M. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1975. 48p. Dep. NTIS $5.45.

The Los Alamos Scientific Laboratory (LASL) entered the nuclear propulsion field in 1955 and began work on all aspects of a nuclear propulsion program involving uranium-loaded graphite fuels, hydrogen propellant, and a target exhaust temperature of approximately 2500°C. A very extensive uranium-loaded graphite fuel element technology evolved from the program. Selection and composition of raw materials for the extrusion mix had to be coupled with heat treatment studies to give optimum element properties. The highly enriched uranium in the element was incorporated as UO_2, pyrocarbon-coated UC_2, or solid solution UC . ZrC particles. An extensive development program resulted in successful NbC or ZrC coatings on elements to withstand hydrogen corrosion at elevated temperatures. Hot gas, thermal shock, thermal stress, and NDT evaluation procedures were developed to monitor progress in preparation of elements with optimum properties. Final evaluation was made in reactor tests at NRDS. Aerojet-General, Westinghouse Astronuclear Laboratory, and the Oak Ridge Y-12 Plant of Union Carbide Nuclear Company entered the program in the early 1960's, and their activities paralleled those of LASL in fuel element development. (auth)

00325 (RAR—652-340-002) **Preliminary failure mode and effect analysis.** Addison, J.V. (Atomics International Div., Canoga Park, Calif. (USA)). 8 Sep 1972. 15p. Dep. NTIS $4.00.

A preliminary Failure Mode and Effect Analysis (FMEA) was made on the overall 5 Kwe system. A general discussion of the system and failure effect is given in addition to the tabulated FMEA and a primary block diagram of the system. (auth)

00326 (RAR—696-13-001) **Reliability analysis of ZrH reactor thermoelectric system.** Burgess, D.S. (Atomics International Div., Canoga Park, Calif. (USA)). 29 May 1968. 17p. Dep. NTIS $4.00.

The reliability of the ZrH reactor thermoelectric system is determined on the basis of reasonably attainable component and subsystem estimates. The system reliability is presented for full and partial power and for both 10,000 hour and 20,000 hour missions. (auth)

00327 (TI—759-240-031) **Fuel element vibration study: design and analysis of a pre-kinked column buckling device.** Anderson, R.V. (Atomics International Div., Canoga Park, Calif. (USA)). 3 Mar 1971. 44p. Dep. NTIS $5.50.

The column buckling device fuel element vibration suppressor has been analyzed and re-designed. Pre-kinking of the column shows resultant lowering of the strain hardening effects of a straight column and the axial deformation required to sustain the total column load. Design of the new CBD is presented and further recommendations are included. 24 references. (auth)

REACTOR SAFETY

00328 (ANCR—1219) **Contempt-LT: a computer program for predicting containment pressure-temperature response to a loss-of-coolant accident.** Wheat, L.L.; Wagner, R.J.; Niederauer, G.F.; Obenchain, C.F. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jun 1975. 231p. Dep. NTIS $7.60.

CONTEMPT-LT is a digital computer program, written in FORTRAN IV, developed to describe the long-term behavior of water-cooled nuclear reactor containment systems subjected to postulated loss-of-coolant accident (LOCA) conditions. The program calculates the time variation of compartment pressures, temperatures, mass and energy inventories, heat structure temperature distributions, and energy exchange with adjacent compartments. The program is capable of describing the effects of leakage on containment response. Models are provided to describe fan cooler and cooling spray engineered safety systems. Up to four compartments can be modeled with CONTEMPT-LT, and any compartment except the reactor system may have both a liquid pool region and an air-vapor atmosphere region above the pool. Each region is assumed to have a uniform temperature, but the temperatures of the two regions may be different. CONTEMPT-LT can be used to model all current boiling water reactor pressure suppression systems, including containments with either vertical or horizontal vent systems. CONTEMPT-LT can also be used to model pressurized water reactor dry containments, subatmospheric containments, and dual volume containments with an annulus region, and can be used to describe containment responses in experimental containment systems. The program user defines which compartments are used, specifies input mass and energy additions, defines heat structure and leakage systems, and describes the time advancement and output control. CONTEMPT-LT source decks are available in double precision extended-binary-coded-decimal-interchange-code (EBCDIC) versions. Sample problems have been run on the IBM360/75 computer. (auth)

00329 (ANL-CT—76-10) **CORTAC: a core restraint transient analysis code. Preliminary user's manual.** Fulford, P.J.; Fox, J.N.; Yackle, T.R. (Argonne National Lab., Ill. (USA)). Jul 1975. 181p. AT.

The FORTRAN IV computer code CORTAC developed by ANL and GE-FBRD for the transient analysis of LMFBR core restraint systems is described. The objective of the code is to allow a simultaneous analysis of the coupled reactor core thermal-hydraulics, structural deflections, and reactor kinetics. CORTAC treats the reactor core system as an axisymmetric model consisting of a central cylindrical region and fifteen concentric annular regions. The thermal-hydraulic simulation includes heat conduction between radial regions, gamma and neutron heating of structure and coolant, and time dependent flow rates within and between each region. Each radial region is divided into a maximum of nine nodes, including four representative fuel pin nodes, and up to thirty axial sections. The transient temperature equations use a recently developed conduction-convection heat transfer computational technique. Structural response of the core assemblies is simulated by a routine based on the NUBOW code, previously developed at ANL. The transient prompt neutron and precursor densities are determined by the standard point kinetic equations. (auth)

00330 (BNWL-B—417) **Models for predicting the removal of airborne contaminants by reactor containment sprays.** Postma, A.K.; Ritzman, R.L.; Gieseke, J.A.; Schmidt, E.W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 27 Jun 1975. Contract AT(45-1)-1830. 122p. Dep. NTIS $5.45.

Mathematical models for spray removal of methyl iodide and aerosol particles, as well as a model for deposition of elemental iodine on wall surfaces have been deduced from available experimental and theoretical information. The models were chosen to yield conservative estimates of fission product removal under postulated accident conditions in water reactors. Important results from this study include the following. Wall deposition of elemental iodine is limited by gas phase mass transfer resistance, and the rate of deposition may be predicted using a mass transfer model which describes transport through a thermally convected boundary layer. The wall deposition rate is small compared to spray washout and is important primarily because it permits total washout to be computed as a sum of wall sorption and spray washout. Methyl iodide absorption is a case of absorption with simultaneous chemical reaction, and may be predicted from models based on stagnant drops and wall films. Due to its comparative inertness, the removal rate constant for CH_3I by aqueous sprays is less than 1 hr^{-1}. Particle removal was predicted using the HAA-3B, modified to account for spray washout. Studies of the particle source term for a meltdown accident indicated that some 9 percent of fission products would become airborne. Primary particles of diameter 0.02 to 0.1 μ m would grow by agglomeration in the primary vessel to sizes of 0.8 to 4 μ m depending on accident conditions. Relatively rapid removal of particles by the spray is predicted, leading to a 2 hr DRF of the order of 9. (auth)

00331 (CONF-750411—8) **Design margin approach in LMFBR nuclear safety.** Graham, J.; Strawbridge, L.E. (Westinghouse Electric Corp., Cheswick, Pa. (USA). Advanced Reactors Div.). 1975. 25p. Dep. NTIS $4.25.

From European nuclear conference; Paris, France (21 Apr 1975).

A new approach recommended for the treatment of core disruptive accidents in LMFBR safety is outlined. In place of the traditional approach in which an extreme assumed core disruption would be treated as a design basis accident for the plant containment, an approach which emphasizes prevention of such events to a confirmable low probability coupled with a margin of protection for unknowns is outlined. In addition, it is shown that the margin of protection may be provided by designing for characterized damage loadings. Recommendations are also made for standardization of these margins through national code committee action. The

Clinch River Breeder Reactor is used as an example of the application of such an approach. 15 references. (auth)

00332 (CONF-750418—3) **Reliability modeling of Clinch River breeder reactor electrical shutdown systems.** Schatz, R.A.; Duetsch, K.L. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1974. 28p. Dep. NTIS $4.50.

From 6. annual conference on modeling and simulation; Pittsburgh, Pennsylvania, USA (24 Apr 1975).

The initial simulation of the probabilistic properties of the Clinch River Breeder Reactor Plant (CRBRP) electrical shutdown systems is described. A model of the reliability (and availability) of the systems is presented utilizing Success State and continuous-time, discrete state Markov modeling techniques as significant elements of an overall reliability assessment process capable of demonstrating the achievement of program goals. This model is examined for its sensitivity to safe/unsafe failure rates, sybsystem redundant configurations, test and repair intervals, monitoring by reactor operators; and the control exercised over system reliability by design modifications and the selection of system operating characteristics. (auth)

00333 (CONF-750468—1) **Decay heat removal for the liquid metal fast breeder reactor.** Zemanick, P.P.; Brown, N.W. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1975. 62p. Dep. NTIS $6.25.

From Specialist meeting on reliability of decay heat removal systems proposed for fast reactors; Harwell, UK (28 Apr 1975).

The functional and reliability requirements of the decay heat removal systems are described. The reliability requirement and its rationale as adequate assurance that public health and safety are safeguarded are presented. The means by which the reliability of the decay heat removal systems are established to meet their requirement are identified. The heat removal systems and their operating characteristics are described. The discussion includes the overflow heat removal service and its role in decay heat removal if needed. The details of the systems are described to demonstrate the elements of redundancy and diversity in the systems design. The quantitative reliability assessment is presented, including the reliability model, the most important assumptions on which the analysis is based, sources of failure data, and the preliminary numerical results. Finally, the qualitative analyses and administrative controls will be discussed which ensure reliability attainment in design, fabrication, and operation, including minimization of common mode failures. A component test program is planned to provide reliability data on selected critical heat removal system equipment. This test plan is described including a definition of the test parameters of greatest interest and the motivation for the test article selection. A long range plan is also in place to collect plant operational data and the broad outlines of this plan are described. A statement of the high reliability of the Clinch River Breeder reactor Plant decay heat removal systems and a summary of the supporting arguments is presented. (auth)

00334 (CONF-750804—3) **Heat transfer and friction correlations required to describe steam—water behavior in nuclear safety studies.** Solbrig, C.W.; McFadden, J.H.; Lyczkowski, R.W.; Hughes, E.D. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1975. 107p. Dep. NTIS $8.50.

From Conference on heat transfer; San Francisco, California, USA (11 Aug 1975).

The description of two-phase flow is important in nuclear safety studies. Recent two-phase flow descriptions are based upon unequal phase velocities and unequal phase temperatures (UVUT) theories with interphase interaction terms. These theories are more mechanistic than homogeneous theories and require more and different types of correlations than homogeneous theories. The UVUT theories require correlations (or models) which describe wall and interphase mass transfer, friction, momentum transfer, and heat transfer for all flow regimes and heat transfer regimes. A set of correlations is presented in this paper which can be used with UVUT theories. These correlations cover the complete range of parameters needed and in all cases are expected to yield reasonable numbers. (auth)

00335 (CONF-750804—4) **Pipe blowdown analysis using explicit numerical schemes.** Lyczkowski, R.W.; Grimesey, R.A.; Solbrig, C.W. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1974. 46p. Dep. NTIS $5.50.

From Conference on heat transfer; San Francisco, California, USA (11 Aug 1975).

Several explicit numerical schemes were investigated to solve the homogeneous equations of change for one-dimensional fluid flow and heat transfer. The most successful technique investigated is the alternating gradient method which is based on the two-step Lax-Wendroff procedure. Agreement with experimental results is very good. (auth)

00336 (CONF-750804—5) **Partial flow blockage effects within a (liquid metal cooled fast reactor) LMFBR fuel assembly.** Bishop, A.A.; Engel, F.C.; Markley, R.A. (Pittsburgh Univ., Pa. (USA). Dept. of Chemical Engineering; Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1975. Contract AT(11-1)-2395. 38p. Dep. NTIS $5.00.

From Conference on heat transfer; San Francisco, California, USA (11 Aug 1975).

A lumped thermal-hydraulic model was used to calculate the increase in the sodium and cladding temperatures in the wake behind a non-porous partial flow blockage within a typical LMFBR fuel rod assembly. The model predicts that over 25 percent of the cross sectional flow area may be blocked before the wake fluid temperature reaches boiling; the actual size depends on the blockage axial location and radial location. Agreement with the limited sodium flow rod bundle blockage data is achieved by the model if the wide variation observed in the experimental cladding temperatures within the wake region is attributed to variations in local heat transfer coefficients. (29 references) (auth)

00337 (CONF-750804—9) **Measurements of velocities downstream of blocked subchannels in a model reactor rod bundle.** Vegter, B.J.; Roidt, R.M.; Pechersky, M.J.; Markley, R.A. (Westinghouse Research Labs., Pittsburgh, Pa. (USA)). 30 Dec 1974. 37p. Dep. NTIS $5.00.

From Conference on heat transfer; San Francisco, California, USA (11 Aug 1975).

Two blockage configurations were installed on the upstream end of a hexagonal grid in an 11:1 scale 39 rod bundle air model of a liquid metal fast breeder reactor. Velocities were measured in subchannels behind and adjoining the blockages. The region of separated flow was found to be five times a characteristic height of the blockages, consistent with other experimental results. The effect of the grids on the length of separated flow was minimal. Flow rates in subchannels centered downstream of the blockages recovered to 90 percent of the upstream flow rates in the 28 rod diameter length between grids. 3 references. (auth)

00338 (CONF-750908—5) **Scram and nonlinear reactor system seismic analysis for the Fast Flux Test Facility.** Morrone, A. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1975. 25p. Dep. NTIS $4.25.

From 3. international conference on structural mechanics in reactor technology; London, UK (1 Sep 1975).

A description is given of the analysis and results for the Fast Flux Test Facility (FFTF) reactor system which was analyzed for both scram times and seismic responses such as bending moments and impact forces. The reactor system was represented with a one-dimensional nonlinear mathematical model with two degrees of freedom per node. The results give time history plots of various seismic responses and plots of scram times as a function of control rod travel distance for the most critical scram initiation times. The total scram time considering the effects of the earthquake was still acceptable but about 4 times longer than that calculated without the earthquake. (auth)

00339 (DP-MS—74-67) **Steam pocket formation from a simulated nuclear excursion in a water-moderated reactor mockup.** Muhlbaier, D.R. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 28p. (CONF-750804—1). Dep. NTIS $4.50.

From Conference on heat transfer; San Francisco, California, USA (11 Aug 1975).

Tests were conducted with a scale model hydraulic facility to determine the behavior of steam injected into subcooled water by fuel assemblies during a postulated nuclear excursion in a Savannah River Plant (SRP) reactor. Results showed that when mockup fuel assemblies are discharging steam, a steam pocket was formed. The steam pocket always remained in the bottom of the tank in contact with its energy source but expanded upward through the tank core at reduced subcoolings. Steam volume and overall heat transfer rate were influenced by the turbulence of both the steam and the water. The steam coexisted with subcooled water. (auth)

00340 (ERDA—1541(Vol.1)(Dr.)) **Light Water Breeder Reactor Program. Volume I. Summary and background. Environmental statement. Draft.** (Energy Research and Development Administration, Washington, D.C. (USA)). Jul 1975. 234p. Energy Research and Development Administration, Washington, DC.

An environmental review of the LWBR Program at the Shippingport Reactor is presented. Topics covered include background information on the program, LWBR core operations at Shippingport, commercial application of LWBR technology, cost-benefit analysis, safety, alternatives to the program, and energy forecasts. (JWR)

00341 (ERDA—1541(Vol.2)(Dr.)) **Light Water Breeder Reactor Program. Volume II. Operation of LWBR core in Shippingport Atomic Power Station. Environmental statement. Draft.** (Energy Research and Development Administration, Washington, D.C. (USA)). Jul 1975. 834p. Energy Research and Development Administration, Washington, DC.

A detailed environmental review of LWBR core operations is presented. Topics covered include effects of construction and operation, monitoring for non-radiological impacts, radiological impact from normal operation, transportation and safeguarding of nuclear materials, accidents, and alternatives to the program. (JWR)

00342 (ERDA—1541(Vol.3)(Dr.)) **Light Water Breeder Reactor Program. Volume III. Commercial application of LWBR technology. Environmental statement. Draft.** (Energy Research and Development Administration, Washington, D.C. (USA)). Jul 1975. 663p. Energy Research and Development Administration, Washington, DC.

An environmental review of the commercial application of LWBR technology is presented. Sections are included on the environmental impact of a conceptual LWBR fuel cycle, unavoidable adverse environmental effects, alternatives, the relationship between short-term uses and long-term productivity, irreversible commitments of resources, and cost-benefit analysis. (JWR)

00343 (ERDA—1541(Vol.4)(Dr.)) **Light Water Breeder Reactor Program. Volume IV. Environmental assessment of a conceptual thorium—uranium fuel cycle.** (Energy Research and Development Administration, Washington, D.C. (USA)). Jul 1975. 756p. Energy Research and Development Administration, Washington, DC.

An environmental review of a conceptual thorium—uranium fuel cycle for LWBR type reactors is presented. Topics covered include mining, milling, enrichment, fuel fabrication, reprocessing, storage, waste management, transportation, and a conceptual integrated fuel cycle facility. (JWR)

00344 (GA-A—13300) **Evaluation of alternative shutdown-systems concepts for the gas-cooled fast breeder reactor.** Antonsen, K.; Cauble, G.L. (General Atomic Co., San Diego, Calif. (USA)). 7 May 1975. Contract AT(04-3)-167. 33p. Dep. NTIS $4.00.

Several existing breeder and thermal reactor shutdown systems, such as those for the LMFBR and HTGR and some new variations, were reviewed and evaluated for potential application to the Gas-Cooled Fast Breeder Reactor (GCFR), with diversity from the GCFR reference control-rod drive system and reliability as the main objectives. (auth)

00345 (GEAP—20936) **Blowdown heat transfer review of recent results.** Sutherland, W.A. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Jul 1975. Contract AT(04-3)-189. 24p. Dep. NTIS $4.00.

The BWR Blowdown Heat Transfer Program is an experimental investigation of BWR system performance and response characteristics under loss-of-coolant accident (LOCA) conditions. Since this is not possible with an actual reactor facility, a scaled test apparatus is used which has system characteristics similar to the reactor. The performance data provide an in-depth understanding of the hydrodynamic and thermodynamic behavior of the LOCA phenomena, such as internal mass distribution, break flow rate and enthalpy, void formation, and core heat transfer mechanisms. These results are being used to verify phenomenological models and computer methods and identify areas where analytical models can be improved. Some of the current findings are summarized. (auth)

00346 (HEDL-SA—983) **Sodium-concrete reactions, liner response, and sodium fire extinguishment.** Hilliard, R.K. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract AT(45-1)-2170. 51p. (CONF-750719—2). Dep. NTIS $5.75.

From Safety technology meeting on radiological consequence assessment; Canoga Park, California, USA (29 Jul 1975).

00347 (HEDL-TME—74-47(Vol.2)) **MELT-III: a neutronics, thermal-hydraulics computer program for fast reactor safety analysis. Volume II.** Waltar, A.E.; Partain, W.L.; Kolesar, D.C.; O'Dell, L.D.; Padilla, A. Jr.; Sonnichsen, J.C.; Wilburn, N.P.; Willenberg, H.J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1974. Contract AT(45-1)-2170. 265p. Dep. NTIS $13.60.

A program listing for the MELT-III code is presented. (JWR)

00348 (ORNL-NSIC—122) **Annotated bibliography of safety-related occurrences in nuclear power plans as reported in 1974.** Scott, R.L.; Gallaher, R.B. (Oak Ridge National Lab., Tenn. (USA)). May 1975. Contract W-7405-eng-26. vp. Dep. NTIS $15.00.

All abnormal occurrences at nuclear power plants reported in 1974 are reviewed and summarized. This bibliography covers the individual reports of each of the 1421 abnormal occurrences reported to the U. S. Nuclear Regulatory Commission, as well as some 455 other documents pertaining to these and other events of note. The review is intended to provide insight as to where additional effort can be expended to improve operations in nuclear power plants. The individual reports, abstracted by the Nuclear Safety Information Center, concern incidents and failures, design or construction deficiencies, and noncompliance citations for license violations. A bibliography is included which contains 100-word abstracts of each incident. For convenience, the bibliography is organized according to type of facility as follows: boiling-water reactors; pressurized-water reactors; non-water-cooled power reactors; and reactors, general. Key-word and permuted-title indexes are provided for each section. (auth)

00349 (ORNL-TM—4914(Vol.1)) **Quarterly progress report on reactor safety programs sponsored by the NRC Division of Reactor Safety Research for January—March 1975. I. Light-water-reactor safety.** (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 117p. Dep. NTIS $5.45.

Progress is reported in the following areas of study: blowdown heat transfer; fission product beta and gamma energy release; and zirconium—water oxidation kinetics. Operations at the Nuclear Safety Information Center are reviewed. The multirod burst tests, LWR fuel fission product release studies, and zircaloy cladding creepdown and collapse investigations are described. (DCC)

00350 (ORNL-TM—4950) **Monthly highlights for Office of Nuclear Regulatory research programs at Oak Ridge National Laboratory.** Fee, G.G. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 42p. Dep. NTIS $5.25.

Summaries are given of the following programs: heavy section steel technology, fission product beta and gamma energy release, LOCA release from LWR fuel, multirod burst tests, Nuclear Safety Information Center, PWR blowdown heat transfer—separate effects, Zircaloy fuel cladding collapse studies, Zr metal—water oxidation kinetics, transient vaporization of LMFBR fuel, and HTGR safety analysis and research. Technical highlights and cost/budget reports are included. (DLC)

00351 (ORNL-TM—5053) **Monthly highlights for Office of Nuclear Regulatory Research programs at Oak Ridge National Laboratory.** Fee, G.G. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 37p. Dep. NTIS $4.00.

Technical highlights and cost/budget data are presented for the following programs: heavy section steel technology, fission product beta and gamma energy release, LOCA release from LWR fuel, multirod burst tests, Nuclear Safety Information Center, PWR blowdown heat transfer-separate effects, zircaloy fuel cladding collapse studies, zirconium metal-water oxidation kinetics, transient release from LMFBR fuel, HTGR safety analysis and research, and design criteria for piping and nozzles. (DG)

00352 (ORO—4313-11) **Molten material-coolant interaction and plutonium source in LMFBR accident analysis. Eleventh and twelfth quarterly reports for the period 1 July 1974—31 December 1974.** (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). Apr 1975. Contract AT(40-1)-4313. 87p. (ORO—4313-12; NE—3949-111-75; NE—3949-112-75). Univ. of Virginia, Charlottesville.

An analytical model was developed for estimating bounding values of fuel-vapor generation and fuel-expansion work in an LMFBR core-disruptive accident. The time-dependent hydrodynamic expansion of fuel in spherical geometry is calculated by the model which was programmed as the FEXPAN code on the CDC-6400 computer. A calculation using the model was made for a specified core-disruptive accident for FFTF. For a 100 $/sec, sodium-out, FFTF disassembly followed by expansion without fuel mixing, the FEXPAN calculations indicated that approximately 9 percent of the fuel would be vaporized and 70 MW-sec of work would be done when the sodium column impacts the cover (at approximately 22 msec after disassembly) and that the spatial pressure distribution in the fuel bubble would become uniform between 4 and 10 msec after disassembly. 10 references. (auth)

00353 (SAND—74-0382) **Core-meltdown experimental review.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Aug 1975. Contract AT(29-1)-789. 472p. Dep. NTIS $13.60.

The results of a study of the experimental evidence having a bearing on hypothetical core meltdowns in light-water reactors are

presented. The first objective of the study was to obtain a compendium of the experimental evidence applicable to the analysis of a hypothetical core meltdown. Literature from the nuclear power field and from other scientific disciplines and industrial sources was reviewed. Investigators and other persons knowledgeable in the subject were interviewed. A second objective was to determine what data are required and to determine the adequacy of existing data. In core-meltdown studies only land-based plants have been examined. A third, and final, task of this study was to examine offshore plants to determine applicability of onshore plant analysis to particular areas therein and to determine what information peculiar to meltdown accidents in offshore plants was needed. (auth)

00354 (TID—26800) **Thermal fuels behavior program monthly report, CRO-119-75.** (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Mar 1975. 28p. Dep. NTIS $4.50.

Research on fuel elements for LWR type reactors included: power-cooling missmatch accident testing; gap conductance testing; irradiation effects and simulation; LOCA testing; and reactivity-initiated accident testing. (JWR)

00355 (TID—26826) **Experimental investigation of the fragmentation of molten metals in water.** Bjorkquist, G.M. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jun 1975. 81p. Dep. NTIS $5.45.

Small amounts of molten tin and bismuth were dropped into water to investigate the fragmentation of molten metals.The major parameter of the experimental program was the initial drop temperature but drop mass and drop material were also varied. The pressure signal of the interaction was recorded, high speed motion pictures of the interaction were made, and the metallic debris was collected. The experiments and analysis were patterned after and were intended to be a continuation of work done by Trond Bjornard. Several important additions were made to the experimental apparatus. Specifically they were a hotter furnace to allow a greater range of initial drop temperature, provision of an argon atmosphere during the melting and dropping of the metal sample to prevent excessive oxidation at high temperatures, and modification of the tape recorder to allow a longer time interval to be recorded. An attempt was made to interpret the dwell time in terms of the cooling of the molten drop. Calculations show that, in the case of tin, drops with an initial temperature greater than 600°C will cool to a temperature in the vicinity of 600°C before fragmenting. (auth)

00356 (TID—26827) **Thermal stress initiated fracture as a fragmentation mechanism in the UO_2—sodium fuel-coolant interaction.** Knapp, R.B. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). May 1975. 201p. Dep. NTIS $7.60.

An analytic study was carried out to determine the applicability of the concept of thermal stress fragmentation to the UO_2/sodium Fuel-Coolant Interaction. Major emphasis was put on the fracture mechanics approach to assessing whether or not the solidifying UO_2 would fracture under the thermally induced stresses. It was found that the stress levels were sufficient to generate K/sub I/ values substantially in excess of the UO_2 fracture toughness, K/sub IC/. Thus, rapid instantaneous propagation of inherent flaws is anticipated. Parametric studies in which the surface heat transfer boundary condition was varied did not alter this conclusion. Extension of the thermal stress fracture concept to Al_2O_3 resulted in similar behavior. Subsequently, this material was selected as a good simulant for use in experimental studies of the mechanism. Additional studies on time led to the conclusion that thermal stress fracture was not an applicable mode of fragmentation inducement in ductile metal/water interactions. It was concluded that thermal stress fragmentation is a feasible mode of fragmentation in the UO_2/sodium system. However, further experimental and analytical work is necessary to establish firm verification of this model. (auth)

00357 (UCLA—34P203-2) **Dry out of a fluidized particle bed with internal heat generation.** Keowen, R.S.; Catton, I. (California Univ., Los Angeles (USA). Dept. of Energy and Kinetics). Mar 1975. Contract AT(04-3)PA203. 59p. (UCLA—24P223-2; UCLA-ENG—7519). Dep. NTIS $6.00.

An apparatus was designed to adequately simulate the characteristics of a particle bed formed by nuclear reactor fuel after the reactor has been operable for some length of time at high power. This was accomplished by using a 10 KW, 453 Kc induction heater, coupled through a multi-turn work coil to particle beds of cast steel shot and lead shot in water. The temperature response and dryout condition was determined for various bed levels, particle diameters, and heat fluxes. Analysis of the data retrieved from the bed was used to generate a family of curves to predict the necessary conditions for dryout to occur within a fluidized particle bed with internal heat generation. The results presented here, with internal heat generation, show that previous results with bottom heating and volume heating are conservative. (auth)

00358 (UCLA-ENG—7472) **Post-accident core retention for LMFBR's. 2. Technical report, 1 July 1973—30 June 1974.** (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Sep 1974. Contract AT(04-3)-34. 149p. (UCLA—34P203-1B). Dep. NTIS $10.50.

This report describes work performed at UCLA on Post Accident Heat Removal for the period July 1973 to July 1974. The work includes a preliminary identification of sequences of events that could lead to a completely disassembled core and analysis of several in-vessel processes relevant to establishing whether or not containment can be achieved. Preliminary observations on the dryout of debris beds are reported. The effects of both stabilizing temperature gradients and thermal radiation on increases in the downward heat transfer from a molten layer of UO_2 are found to be significant. Boiling of the molten layer is considered and the existing experimental data is found to be inadequate. Predictions of heat transfer from a downward facing surface to a low Prandtl number fluid are not available. Recommendations for future work are made. The effects of disturbances on a quiescent molten layer are presented. A simple fast method of estimating recriticality is given and an estimate of possible ramp rates is made. Areas of uncertainty requiring further work are identified. (auth)

00359 (UCRL—51718) **Fault tree analysis of the LPTR scram system.** Mortensen, W.K.; Savage, J.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Dec 1974. Contract W-7405-Eng-48. 45p. Dep. NTIS $4.00.

The protective control or scram system of the Livermore Pool Type Reactor (LPTR) has been subjected to fault tree analysis to determine its vulnerability to various component failures or other untoward events both credible and incredible. This report describes the analysis and discusses the results. The principal result is that no single component failure nor any single credible event can result in a failure of the reactor to scram when a scram is required. (auth)

00360 **Nuclear power safety and the public.** Ray, D.L. (Atomic Energy Commission, Washington, DC). pp vp, 5p of **Nuclear controversy in the U.S.A. II.** New York; Atomic Industrial Forum Inc. (1974).

From Workshop on the nuclear controversy in the U.S.A.; Lucerne, Switzerland (5 May 1974).

See CONF-740596—.

The problems involved in informing the public concerning the safety of nuclear power are discussed. The importance of making known the alternatives to the rapid development of nuclear power is emphasized. (JWR)

00361 **Environmental impact on breeder reactors for power generation.** Cope, D.F. (Atomic Energy Commission, Oak Ridge, TN). pp 345-358 of **Air pollution control and industrial energy production.** Noll, K.E. (ed.). Ann Arbor, MI; Ann Arbor Science Publishers Inc. (1975).

The characteristics of the LMFBR are reviewed and compared to those of typical light water reactors. Those features of the LMFBR are examined which are important in environmental and safety considerations, and expected impacts on air quality, water quality and solid wastes are discussed. (DG)

00362 **External hazards as they affect nuclear power plant siting.** Grimes, B.K. (Atomic Energy Commission, Washington, DC). pp 133-142 of **Siting of nuclear facilities.** Vienna; International Atomic Energy Agency (1975).

From Symposium on siting of nuclear facilities; Vienna, Austria (9 Dec 1974).

See STI/PUB—384; CONF-741210—.

The USAEC Regulatory Staff (soon to be known as the Nuclear Regulatory Commission) has recently issued guidance to utilities in the areas of man-made hazards and natural phenomena which may influence availability and development costs of candidate nuclear power plants. They are in the form of regulatory guides and revisions to the standard format and content of safety-analysis reports. It has also issued guides to its own staff in the form of review plans, some of which have been recently completed and made available to the public. A summarization is presented of the USAEC guides now available on the subject of external hazards, and typical hazards are discussed which are given attention by the regulatory staff in the course of the review of an application to construct a nuclear power plant. (auth)

00363 (ORNL-tr—4003) **Experience in operation of Phenix with regard to shielding.** Goddet, J.; Peyresblanques, H.; Galissian, F.; Meffre, P. 1975. Translation of French report. (CONF-750411—10). 6p. Dep. NTIS $4.00.

From European nuclear conference; Paris, France (21 Apr 1975).

A description is given of studies to determine the operational hazards at the Phenix reactor due to radioactivity and to sodium fires and sodium-water reactions. It is concluded that the operation of Phenix during the first year of full-power production did not indicate any appreciable problems for operating personnel or for the environment. (DG)

00364 **Nuclear fuel pin controlled failure device.** Schlenker, L.D. (to U.S. Energy Research and Development Administration). US Patent 3,886,037. 27 May 1975. Filed date 17 Aug 1973. 7p.

PAT-APPL-389,287.

Each fuel pin of a fuel assembly for a water-cooled nuclear reactor is provided with means for rupturing the cladding tube at a predetermined location if an abnormal increase in pressure of the gases present occurs due to a loss-of-coolant accident. Preferably all such rupture means are oriented to minimize the hydraulic resistance to the flow of emergency core coolant such as all rupture means pointing in the same direction. Rupture means may be disposed at different elevations in adjacent fuel pins and, further, fuel pins may be provided with two or more rupture means, one of which is in the upper portion of the fuel pin. Rupture means are mechanical as by providing a locally weakened condition of a controlled nature in the cladding. (Official Gazette)

ENERGY STORAGE

MAGNETIC

00365 (LA—5953-MS) **Design of a force-free inductive storage coil.** Mawardi, O.K. (Los Alamos Scientific Lab., N.Mex. (USA)). Apr 1975. Contract W-7405-ENG-36. 11p. Dep. NTIS $4.00.

Force-free coils have been considered for various applications as energy storage devices. A novel energy storage system consisting of both toroidal and poloidal coils has been developed. In this system, the Lorentz forces on the two coils are in opposition and can be made to cancel by having the proper ratio of ampere-turns in the two coils. A general discussion of force-free coil design is given, and the toroidal-poloidal coil system is described. The materials costs of magnets constructed with this and other geometries are compared. The conclusions are that conductor cost of this system lies between those of solenoids and toroids, and that the costs of structural material may be considerably less than either of these simpler coils. (auth)

THERMAL

00366 (ERDA—59) **Survey and selection of inorganic salts for application to thermal energy storage.** Borucka, A. (Borucka Research Co., Livingston, N.J. (USA)). Jun 1975. 129p. Dep. NTIS $5.45.

Thirty-six inorganic single salts, 32 binary salts, and 12 ternary salts were evaluated for their applicability to thermal energy storage at temperatures from 200°C to 1000°C. The corrosive aspects of these salts are discussed briefly. The experimental methods used for evaluating the physical and thermal properties of fused salts are summarized. It was concluded that: alkali chlorides, fluorides, and a number of related binary and ternary salts are promising for thermal energy storage; with a few exceptions, inorganic salts in general show a very large increase in volume upon melting (up to 40 percent) which must be tolerated by proper hardware design if molten salts are to be successfully used in the storage of thermal energy at high temperatures; available experimental data on properties of many salts (and especially on the binary and ternary systems) is deficient and not fully reliable in many cases; and further accurate property and corrosion studies are mandatory for the particular salts selected. (LCL)

BATTERIES

DESIGN AND DEVELOPMENT

00367 (APTD—1126) **Development of high-energy batteries for electric vehicles. Progress report for the period February 1969—June 1970.** Cairns, E.J.; Kyle, M.L.; Maroni, V.A.; Shimotake, H.; Steunenberg, R.K.; Tevebaugh, A.D. (Argonne National Lab., Ill. (USA)). Jul 1970. 60p. (PB—197576). Dep. NTIS $4.25.

The Chemical Engineering Division of Argonne National Laboratory is investigating the performance characteristics of lithium/chalcogen cells to evaluate their applicability as secondary (electrically rechargeable) batteries for vehicular propulsion. During this period, the experimental investigations were directed toward the Li/LiF--LiCl--LiI/Li in S, Li/LiBr--RbBr/Li in S, Li/LiBr--RbBr/Li in P_4S_{10}, and Li/LiBr--RbBr/Li in P_4S_3 cells at temperatures from 325 to 400°C. Small-scale (approximately 1-cm² electrode area) liquid and paste electrolyte cells were operated to determine those conditions under which the cells will deliver current densities of 0.3 to 1 A/cm² for a large fraction of their capacity densities. Cell performance is believed to be limited by the low diffusion rate of the cell reaction products away from the sulfur-electrolyte interface and the low electronic conductivity of sulfur. A modification of the cell design to provide an increased sulfur-electrolyte interfacial area by means of a laminated cathode structure resulted in increased cell performance. Corrosion tests of potential materials of construction for lithium/sulfur cells were made with a variety of materials. (17 figures, 8 tables) (RWR)

00368 **Secondary electrochemical power-producing cells having mixed cathode composition.** Gay, E.C.; Shimotake, H.; Cairns, E.J.; Walsh, W.J. (to U.S. Energy Research and Development Administration). US Patent 3,884,715. 20 May 1975. Filed date 28 Sep 1973. 15p.

PAT-APPL-401,729.

A secondary electrochemical power-producing cell including an anode containing a molten alkali metal of low electronegativity, an electrolyte containing alkali-metal ions, and a cathode containing a mixture of a chalcogen and a component which reduces the activity of said chalcogen in the electrolyte, thereby inhibiting transfer of the chalcogen from the cathode to the anode and increasing the cell life, is described. (4 figures) (auth)

00369 **Thermal battery.** Bush, D.M. (to U.S. Energy Research and Development Administration). US Patent 3,885,989. 27 May 1975. Filed date 30 May 1974. 7p.

PAT-APPL-474,549.

An improved thermal battery of the type which includes an electrically conductive heat generating disc, a calcium anode, and a depolarizer—binder—electrolyte (DEB) mixture pellet positioned within each electrochemical cell is described. Each cell includes calcium hydroxide mixed in the DEB pellet. (4 figures) (auth)

00370 **Modular electrochemical cell.** Walsh, W.J.; Chilenskas, A.A.; Cairns, E.J.; Nelson, P.A. (to U.S. Energy Research and Development Administration). US Patent 3,887,396. 3 Jun 1975. Filed date 15 Nov 1973. 11p.

PAT-APPL-416,311.

A high-temperature alkali-metal/chalcogen electrochemical cell includes a porous cathode interposed between two porous anodes within a disk-shaped housing. The electrodes are electrically separated by a cloth of insulating material, and current flow is provided through a molten electrolyte which permeates the cloth. Electrical terminals from the cathode and the anode extend axially from opposite surfaces of the housing and are of mating prong and socket construction to permit stacking of a plurality of cells in electrical series. (auth)

ENERGY MANAGEMENT AND CONSERVATION POLICY

CONSERVATION

00371 (NSF/RA/N—74-123) **Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.** (Ohio State Univ., Columbus (USA)). 1974. 343p. (CONF-740591—).

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

This conference was held for the purpose of disseminating timely information about current and proposed energy conservation program in the USA. Abstracts were prepared for twenty-eight papers presented at the conference. Two papers, Energy Conservation in Multi-Family Complexes and Future Changes in Codes and Standards Affecting Commercial Buildings were not available for inclusion in the proceedings. (MCW)

00372 (NSF/RA/N—74-123, pp 145-157) **Energy conservation: a major national challenge.** Eggers, A.J. Jr. (National Science Foundation, Washington, D.C.). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

00373 (NSF/RA/N—74-123, pp 159-162) **Variable volume systems for energy conservation.** Gorchev, D. (Mitco Corp., Sommerville, MA). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

The inefficiencies of the constant volume reheat system, the by-pass system, and the dual duct constant volume system are discussed. The heating and air conditioning system in a car and baseboard radiation are VAV systems. This is air circulation around the fins. If the temperature of the hot water is 200°, there is much more air motion than if the temperature is 130°. Some of the advantages of the VAV system are listed. Savings in the initial costs are discussed. Fans can be sized smaller than those in all-air constant volume systems, since fan capacity is based on the peak instantaneous demand of the entire spaces, rather than the sum of all the space peak demands. Savings in space are indicated since smaller air handling systems require less space, giving the owner more rentable or usable space. Savings in operating costs are indicated when energy consumption is reduced because of reduced fan horsepower, refrigeration machinery, and elimination of reheat. No excessive air movement in winter is an advantage. In constant volume systems, supply air volume is generally determined by summer peak cooling load that results in excessive air movement in exterior zones in winter. VAV system provides decreased air flow in winter that is more comfortable. Costly field balancing is minimized. Since VAV systems are self-balancing and all the variable volume devices are factory preset, field balancing is kept to a minimum. With VAV systems, air can be supplied only to the occupied spaces while the rest of the building is not occupied, without any re-balancing problem. (MCW)

00374 (NSF/RA/N—74-123, pp 173-184) **Energy conservation programs for computerized control centers.** Janisse, N.J. (Johnson Service Co., Milwaukee). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

Energy conservation programs are flexible and each program may take advantage of other associated programs to permit maximum system economies. Cost and energy reduction functions are presented for electric demand prediction and limiting; maintenance management; programmed start/stop; elevator scheduling; fire and security; and lighting control. The programs and their implementation are described. These include the true economizer cycle program, that includes an interpretation of the psychrometric chart; distribution profile program; chiller plant optimization program; and optimal start time for HVAC equipment program. Savings in each energy conservation measure are summarized. (MCW)

00375 (NSF/RA/N—74-123, pp 185-214) **Design parameters for energy conservation in new and existing buildings.** Hellmer, G.F. (Hellmer and Medved, Consulting Engineers, Kansas, City, MO). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

Eight basic steps for energy conservation are discussed,i.e., eliminate simultaneous heating and cooling of a room or zone; reduce cooling and heating capacities when load is reduced without wasting energy; design systems to operate at or near optimum efficiency with reduced building loads; reduce heating and cooling losses through building envelope; cool with outside air whenever possible; select equipment for efficient operation in lieu of only first cost consideration; select light levels and sources to reduce energy consumption; and enforce energy conservation. Building data sheets and utility graphs illustrate variations in heating, ventilation, and air conditioning in Washington, D. C., Memphis, San Antonio, Omaha, Bismarck, Richmond, Dallas, Kansas City, and the Commerce Tower in Kansas City, Missouri. (MCW)

00376 (NSF/RA/N—74-123, pp 215-230) **Planning and installation of building control computers at 1 IBM Plaza, Chicago.** Moss, R. (IBM Corp., White Plains, NY). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

The annual energy bill of one million dollars for the building gave reason for an investigation of computer control for energy use and better use of operational manpower. McDonnell Douglas Automation Center, using their energy simulation model, demonstrated an energy savings potential of 25%. A variety of application areas were investigated and based on the ability to identify tangible savings, four areas were selected: heating, ventilating, air conditioning, lighting control, electric power demand load shedding, and building maintenance control. The computer control system was under the direction of the Real Estate and Construction Division of IBM. The system would monitor and control mechanical and electrical systems that would increase operating efficiencies over that resulting from conventional building operation. Tangible savings would be expected to justify the costs of the computer system including hardware, software, and sensors. Annual savings determined from actual operational exercence was $140,000 for electric power and $73,000 for manpower. Net annual savings was $195,000. The payback was 3.3 years and with energy costs escalating, it is very likely to be more favorable in future years. (MCW)

00377 (NSF/RA/N—74-123, pp 231-246) **Computer modeling techniques for building energy conservation.** Meriwether, R.F. (Meriwether and Associates, Consulting Engineers, San Antonio). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

An examination is made of the HVAC system in an office building at Ohio State University. The actual system, a thermodynamic model of the system, and the results of modeling various energy conserving modifications to the actual system are described. The actual system is basically a double-duct system with zone thermostat control of the dampers in several mixing boxes throughout the building. This system is thermodynamically identical to a conventional terminal reheat system although the two systems bear little physical resemblance. It is possible to create an accurate thermodynamic model of a building and its associated energy system in which the inferred physical components bear little or no resemblance to the counterparts of the actual system. It is shown how the model can be used to test various changes in system design or operation that might have a potential for energy conservation in the actual installation, such as showing the electric energy savings that could be realized by just changing the upper temperature limit on the economizer cooling control in the summer cycle from 50 to 65 F. The difficulty of predicting trends and magnitudes in complex energy system is illustrated. It was found that computer modeling is often more practical, economical, and informative than field testing of various energy conservation effects. (MCW)

00378 (NSF/RA/N—74-123, pp 273-283) **Future challenges of buildings of tomorrow.** Ware, T.E. (Building Technology, Inc., Silver Spring, MD). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

A comprehensive, integrated, problem solving approach to today's and tomorrow's building challenges will have to look at the full spectrum of social, economic, and physical factors affecting building. Buildings are used to support the production of goods and services. The energy expended to fulfill that purpose affects the price of products and services. The amount and cost of energy to operate buildings has generally not been an important factor in building design, since energy was abundant and inexpensive. Consequently, energy has not been a significant part of the price of products and services. The design of energy conserving buildings in an era of scarce, expensive energy can have a direct, beneficial effect on the cost of products and services. In supporting the production of goods and services, buildings provide occupants with an interior environment that enhances efficiency and productivity. Design has concentrated more and more on providing high performance interior environments. The heating, cooling and lighting essential to efficiency and productivity has contributed to reductions in the costs of producing products and providing services, and increases in their quality. Significantly reducing interior environmental quality in response to either a reduction in the supply of energy, or an increase in its cost can adversely affect productivity, and hence, the cost and quality of services and products. Success in meeting the challenges depends upon addressing the issues of cost, time, and quality. (JCW)

00379 (NSF/RA/N—74-123, pp 285-293) **Overview of energy-saving design concept in recent and proposed projects.** Stein, R.G. (Richard G. Stein and Associates, New York). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

A review of the building practices in the past centuries that dealt with comfort conditioning is made. The first example illustrated is the first solar building in the U. S. at Mesa Verde. It is constructed with the principles of where the sun rises and sets, where you want it, and where you do not want it; in other words, very carefully sited. It has good insulation factors in the roof and is built with a good knowledge of the heat retention and thermal lag characteristics of heavy masonry construction. Similar construction is cited at Pueblo Bonito and Acoma, New Mexico. The Eskimo snow house is shown to be a delicately engineered structure. Some countyard buildings that are cut into the earth in Hunan, China with their excellent thermal conditions are described. After showing the illustration of a small brick building in Croton with its fenestration engineering, the author describes the research project with the NSF, the National Bureau of Standards, and the Board of Education in New York that is developing ways to measure the things that happen in school buildings. Research dealing with the lighting systems, ventilation, and operating efficiency are described. It is shown that architectural decisions have very little to do with what happens in the spaces themselves. (MCW)

00380 (NSF/RA/N—74-123, pp 309-321) **NSF/RANN energy conservation program.** Wetmore, W.H. (National Science Foundation, Washington, D.C.). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

The research applied to National Needs programs are programs to give policy makers the kind of data analysis necessary to select intelligently from various conservation options. The program is structured in four major areas. The first is the development of a data base which leads to identification of energy intensive areas, and helps identify where research can be applied and have the greatest leverage. Second, RANN is looking for immediate areas of application where procedures and practices can be applied, such as in lighting, ventilation, and insulation. Third, RANN is looking for facilities to modify current homes and buildings to retrofit. Fourth, RANN is looking for the development of methodology and optimization techniques that permit application of experience to all new construction. In all of these areas, the examination of policy and regulatory options is paramount. The total RANN energy research program on conservation was discussed and includes residential/commercial, industrial energy conservation, transportation energy conservation, and power generation. The total energy research program is closely related with solar, geothermal, and other energy programs. (MCW)

SUPPLY, DEMAND, AND FORECASTING

00381 (NSF/RA/N—74-123, pp 104-112) **Energy crisis: real or imaginary.** Schoenberger, P.E. (Ohio State University, Columbus). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

Since 1920, the energy usage in the U. S. has nearly doubled every fourteen years. Until recently, supply was increased to satisfy the demand. The oil companies have been prevented from developing major new oil sources on the continental shelves and in Alaska, and it was necessary to rely on imported oil to satisfy the increases in consumption. In 1972, oil supplied 46% of energy sources; gas, 32%; coal, 17%; with nuclear, hydroelectric, etc., 5%. It is concluded that immediate action should be taken to develop the sources and reserves available within the U. S. It is assumed that energy available in the U. S. will not be enough to allow for normal growth, though, and energy conservation should be practiced. Increased energy costs will encourage elimination of wastes. Costs may make elimination of the wastes mandatory. (MCW)

00382 (NSF/RA/N—74-123, pp 265-271) **Future innovative design in building construction.** Jones, R.A. (Univ. of Illinois, Champaign). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

Energy conservation measures in residential building design have heretofore been in operating costs balanced against initial expenditures. In schools and other public buildings, operating costs have been considered minor, with first costs being kept minimal. First costs are kept low in commercial buildings, and energy consumption costs are regained in product costs. Probable changes that will or should take place in buildings to be built in the U. S. are changes in thermal characteristics of the enclosing building elements; changes in configuration and fenestration; and changes with respect to the heating, cooling, ventilation, and lighting equipment. The thermal characteristics of the enclosing building elements and changes in configuration and fenestration are discussed in detail. Other than the construction criteria described for conservation, consideration for building orientation as practiced by South American architects is advocated. (MCW)

00383 (UCRL—52000-75-7, pp 1-8) **Energy perspectives. Energy: a plan for action.** Teller, E. Jul 1975.

Lawrence Livermore Laboratory energy and technology review.

Dr. Edward Teller has prepared a comprehensive program to meet U. S. energy needs by the year 2000. With the goal of obtaining adequate energy that is inexpensive, clean, and secure, he examines the measures needed to achieve U. S. energy self-sufficiency before 1985 and the costs of such measures. Excerpts from his report, Energy—A Plan for Action, prepared for the Commission on Critical Choices for Americans are presented. (auth)

UNCONVENTIONAL SOURCES AND POWER GENERATION

SOLAR

00384 (NSF/RA/N—74-123, pp 295-304) **Solar energy assisted heating systems for commercial buildings.** Gilman, S. (Pennsylvania State Univ., State College). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

Data are to be collected from the Solar Building in Albuquerque, New Mexico during the winter heating season beginning October 1, 1974. A computer program was developed to model the solar collector and the building heating and cooling loads individually for north and south zones. The results of the computer model will be correlated with data collected at the building. Results to date show that the combination of a water-type solar energy collector, a water source tank, and water source heat

pump units can provide an excellent energy conservation system for commercial buildings. For maximum efficiency of the solar collector the entering water temperature should be low. Water source heat pumps can elevate this low temperature energy to a level high enough for useful heating. During sunny afternoons many of the heat pumps are on cooling cycle. Both the rejected heat pumps and that absorbed by the solar collector are not needed then and it is directed to the storage tank for nighttime heating. Considerable solar energy can be collected from a relatively small collector, i.e., 13% of the building floor area. Heat pump power consumption is reasonable, particularly in view of the moderate coefficient of performance values used in the analysis. The computer is an effective tool for studying the dynamics of such systems. These data are being developed for application to designs of similar solar energy assisted systems in any geographical area of the U. S. (MCW)

00385 (NSF/RA/N—74-123, pp 305-308) **Future possibilities for the use of solar energy in buildings.** Eibling, J.A. (Battelle Memorial Inst., Columbus, OH). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

The technology for solar heating and cooling is available, but innovations are needed in the areas of systems engineering, materials, manufacturing, and marketing. Solar energy is two times more expensive presently than conventional energy sources, but with fuel costs continuing upwards, the parity may be reached before the year 2000. Congress has authorized a Federal solar program led by the National Science Foundation of at least $200 million dollars over a 5-year period. An examination of past studies and experiences on solar energy is made. It is stated that the use of a liquid heat-transfer medium will be easier to manage in solar design for heating, cooling, and water heating. For comfort heating only, air is the easier medium to use. Cost differences are quoted. Various orientations and designs of housing are cited. It is estimated that solar energy is making such good progress that by the year 2000, one-third of the heating and cooling could be supplied by solar energy, representing about 7% of the projected total energy demand. (MCW)

00386 **Solar tower concentrator: an energy alternative.** Hildebrandt, A.F. (Univ. of Houston, TX). *Aware;* No. 60, 12-14(Sep 1975).

Research on the solar tower concentrator at the Solar Energy Laboratory, University of Houston, is described. The heliostat prototype is in operation in the Mohave Desert. The integration of solar energy into the utility grids must consider two factors: the intermittent nature of solar energy and the peak loads of early-evening electricity use. The configuration of the tower can be varied to produce more power in the afternoons than in the morning, but some form of storage will be required for peak periods and cloudy days. The six-hour thermal storage capacity of the square mile tower plant consisting of hot liquid hydrocarbons could be supplemented by gas-turbine peaking plants. Storage in earth strata is another possibility. A promising alternative process, EVA-ADAM, uses heat to convert methane and water into hydrogen and carbon monoxide; decomposition occurs after passing methane and water over a heat-activated catalyst; the resulting hydrogen and carbon monoxide can be stored or piped to the user via a gas line; the user reconstitutes the original compounds by passing the gases over the second catalyst, and the energy is released; and the methane is returned to the power source in a second pipe to complete the cycle. The advantages of solar energy include: the Earth's atmospheric energy balance would not be disturbed; atmospheric pollution would be reduced; fossil fuels would be reserved for more sophisticated uses; there would be no waste disposal problems; the energy source is unlimited; and land areas of low productivity could be utilized. With the EVA-ADAM system, there is no visual pollution since the pipelines are installed underground. (MCW)

ENERGY CONVERSION

MHD GENERATORS

DESIGN AND DEVELOPMENT

00387 **Two-phase liquid-metal magnetohydrodynamic (MHD) generator.** Petrick, M.; Cutting, J.C.; Amend, W.E.; Cole, R.L. (to U.S. Energy Research and Development Administration). US Patent 3,878,410. 15 Apr 1975. Filed date 21 Feb 1974. 12p. PAT-APPL-444,601.

Dissipative boundary layer electrical shunts are eliminated in a two-phase liquid-metal magnetohydrodynamic (MHD) generator by displacing the slow moving, conducting liquid boundary layer adjacent the insulating walls of the generator with a thin gas layer. This is accomplished by injecting an inert gas into the generator channel in the direction of flow of the working fluid through the insulating walls at several locations through a narrow slit extending across the insulating walls. (auth)

PERFORMANCE AND TESTING

00388 (CONF-750810—1) **Investigation of two-phase liquid-metal magnetohydrodynamic power systems.** Amend, W.E.; Fabris, G.; Cutting, J. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-eng-38. 14p. Dep. NTIS $4.00.

From International seminar on future energy conversion in heat and mass transfer problems; Dubrovnic, Yugoslavia (25 Aug 1975).

A two-phase Liquid-Metal MHD (LMMHD) system is under development at the Argonne National Laboratory, and results are presented for detailed cycle analysis and systems studies, the experimental facility, and the thermal and magneto fluid mechanics problems encountered. The studies indicate that the LMMHD cycle will operate efficiently in the temperature range of 1000-1600°F (50 percent efficiency with a maximum cycle temperature of 1600°F) and is therefore potentially compatible with many advanced heat sources under development such as the LMFBR, fluidized-bed coal combustor, HTGCR and the fusion reactor. Of special interest is the coupling to the LMFBR thereby eliminating the costly, potentially hazardous liquid-metal/water interface. The results of detailed parametric studies of the heat transfer interfaces between an LMMHD power cycle and an LMFBR and a steam bottoming plant are described. Experimental evaluation of the two-phase LMMHD generator was performed in an ambient temperature NaK—N_2 facility at ANL. Results of these experiments, performed to determine the operating characteristics of the device as a function of the various independent parameters and to investigate two-phase flow, are given. (auth)

MATERIALS, COMPONENTS, AND AUXILIARIES

00389 (BNWL-SA—5503) **MHD materials testing and characterization: why, how, and where.** Bates, J.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-1830. 10p. (CONF-750669—1). Dep. NTIS $4.00.

From US-USSR Colloquium Panel; Washington, District of Columbia, USA (5 Jun 1975).

Interest and activity in the United States to develop an open-cycle, coal fired MHD power generator has increased significantly. Although the materials problems relating to these severe environments have been recognized, little correlated effort has been directed to their solution. The major emphasis in MHD has been devoted principally to the demonstration of engineering and fundamental feasibility of MHD systems, principally in generator development. For this reason, testing of materials in these MHD systems has generally been given a secondary role. However, the need for a comprehensive materials research and development program is becoming more evident, especially programs involving the evaluation of materials under MHD environments. It is the purpose of this paper to emphasize the need for correlated planning in testing and characterization of MHD materials so as to derive the maximum benefit. (WHK)

00390 **Production of MHD fluid.** Lacey, J.J.; Kurtzrock, R.C. (to U.S. Energy Research and Development Administration). US Patent Application534,328. Filed date 19 Dec 1974. 15p.

A hot gaseous fluid of low ash content, suitable for use in open-cycle MHD (magnetohydrodynamic) power generation, is produced by means of a three-stage process comprising (1) partial combustion of a hydrocarbon fuel to produce a hot gaseous product comprising CO_2, Co, and H_2O, (2) reformation of the gaseous product from stage (1) by means of a fluidized char bed, whereby CO_2 and H_2O are converted to CO and H_2, and (3) combustion of CO and H_2 from stage (2) to produce a low ash-content fluid (flue gas) comprising CO_2 and H_2O and having a temperature of about 4000 to 5000°F. (auth)

THERMOELECTRIC GENERATORS

PERFORMANCE AND TESTING

00391 (LA—5916) **Performance of multihundred-watt fueled-sphere assemblies in the safety sequential test program.** Cramer, E.M. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. 22p. Dep. NTIS $4.00.

Five fueled-sphere assemblies similar to those proposed for use in the multihundred-watt radioisotope thermoelectric generator were subjected to conditions simulating earth impact after orbital abort. Of the five, one had no visible cracks, two had superficial cracks whose penetration of the iridium containment shell was not verified by metallography, one was obviously ruptured, and the fuel of one was exposed. The basic causes of containment failure were as follows: large-grained iridium provided short, straight boundary paths susceptible to intergranular fracturing; large plutonia fragments produced excessive tensile strain in the containment where it was forced to bend over their projecting edges at the moment of impact; vents failed because of sintering and CVD of nonmetallic materials in the filter frits; and, of less significance, directional grain growth in closure welds apparently caused one failure. (auth)

MATERIALS, COMPONENTS, AND AUXILIARIES

00392 (LA—5932) **Degradation of pioneer-type tantalum alloy-PuO_2 heat sources.** Mulford, R.N.R. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. 14p. Dep. NTIS $4.00.

The tantalum alloy T-111 is evaluated for the strength member in Pioneer-type heat sources. Emphasis is on the alloy's retention of ductility during the period between manufacture and launch. Test results of several heat sources that were operated in generators during the Pioneer program are given along with predictions of storage lifetime. The properties of T-111 as a function of oxygen content are assessed. The conclusion is that oxygen concentrations up to 400 ppM by weight are acceptable for launch. (auth)

THERMIONIC CONVERTERS

DESIGN AND DEVELOPMENT

00393 **Improved thermionic converter.** Rasor, N.S.; Britt, E.J. (to U.S. Energy Research and Development Administration). US Patent Application539,746. Filed date 9 Jan 1975. 14p.

A gas-filled thermionic converter is provided with a collector and an emitter having a main emitter region and an auxiliary emitter region in electrical contact with the main emitter region. The main emitter region is so positioned with respect to the collector that a main gap is formed therebetween and the auxiliary emitter region is so positioned with respect to the collector that an auxiliary gap is formed therebetween partially separated from the main gap with access allowed between the gaps to allow ionizable gas in each gap to migrate therebetween. With heat applied to the emitter the work function of the auxiliary emitter region is sufficiently greater than the work function of the collector so that an ignited discharge occurs in the auxiliary gap and the work function of the main emitter region is so related to the work function of the collector that an unignited discharge occurs in the main gap sustained by the ions generated in the auxiliary gap. A current flows through a load coupled across the emitter and collector due to the unignited discharge in the main gap. (auth)

POWER CYCLES

00394 (CONF-750812—8) **Design study for a coal-fueled closed cycle gas turbine system for MIUS applications.** Fraas, A.P.; Holcomb, R.S.; Lackey, M.E.; Tudor, J.J. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. 30p. Dep. NTIS $4.00.

From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).

A summary of a feasibility study of the use of a fluidized bed coal combustion system coupled to a closed cycle gas turbine for MIUS applications was presented at the 1974 IECEC meeting. Work on this concept has proceeded at ORNL under ERDA and HUD sponsorship, and a firm design for a pilot plant has been evolved after considering a wide variety of possibilities and their relative merits in meeting the basic requirements. A summary of the work is presented. The principal features of the design of the complete pilot plant are presented. It is planned that the components for this plant will be fabricated, assembled, and installed for test in the course of the latter part of 1975 and 1976. (auth)

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

BUILDINGS

00395 (NSF/RA/N—74-123, pp 49-52) **ASHRAE's views on the NBS "draft design and evaluation criteria for energy conservation in new buildings".** Kirkwood, R.R. (John Graham and Co., Seattle). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

The proposed Standard 90P, Design and Energy Conservation in New Buildings, is discussed. The National Conference of States on Building Codes and Standards requested the National Bureau of Standards to formulate a document for the improvement of thermal efficiency in new buildings. Consultants from the building industry have aided the NBS in revising the draft into a final document. Developments in committee meetings, reviewers's comments, and final technical decisions are summarized. The draft will apply to one and two family homes, since FHA Standard 51B and ANSI A119 (mobile homes), to be revised, are referenced in the document as applying. Basic industrial plants are included, but industrial buildings with special exhaust and supply problems are special cases and cannot be covered by a standard. (MCW)

00396 (NSF/RA/N—74-123, pp 91-97) **Solutions to problems of energy conservation in existing buildings.** Imperatore, T. (Cushman—Wakefield, New York). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

It is essential that management develop a feasible program that will allow for major changes architecturally, mechanically, and electrically in existing buildings if energy conservation is to be effectively executed. Some problems that exist in buildings 25 years or older that are discussed and their solutions are: obsolete heating, ventilating, and air conditioning; poor lighting systems; poor elevatoring service; leaky fenestration; and poor core-to-gross area ratio. It is concluded that a well planned improvement program can reduce energy use by 50% and would justify its cost. A program for improved energy conservation in buildings constructed during the last 25 years is presented for computer monitoring of all mechanical and electrical systems; the heat pump cycle; a cooling system without the operation of the compressor; and a remote lighting control system. It has been shown that the cost of the installation of the equipment for these innovations can be effected in the cost of the fuel in less than three years. (MCW)

00397 (NSF/RA/N—74-123, pp 113-120) **Methodology of examining existing buildings with the intent of applying energy conserving measures.** Schoenberger, P.E. (Ohio State University, Columbus). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

Actual operation of the facility is determined by traversing supply, return and exhaust air ducts to determine the actual air distribution; by reading motor amperage; by room surveys to establish use and equipment loads, by monitoring supply, return, mixed air, and space temperatures; and by comparing actual usage from metering records with total energy usage. Energy conserving techniques are applied and examined through operational tests and calculations to determine their acceptability. Techniques for the electrical and mechanical systems are described and cost estimates for implementing the energy conservation measures are determined and estimated payback periods derived. (MCW)

RESIDENTIAL

00398 (NSF/RA/N—74-123, pp 1-19) **Energy conservation in residential buildings.** Sepsy, C.F. (Ohio State Univ., Columbus). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

Dynamic responses associated with a single dwelling residence are examined in order to determine varying effects on energy conservation. A study is being performed on two-story residential homes in the Columbus area. Energy is being monitored for all important appliances and equipment in the structures, such as water flow, room temperatures, gas flow, electrical usage for the major appliances, air flow rates, opening and closing of doors, and others, up to 80 data points. Energy and temperature measurements are read every 15 minutes, stored, and averaged every hour. The control house is a new structure, does not have any appliances, is void of inhabitants, and completely free of infiltration due to wind pressure, except for the visit by the technician weekly. Infiltration is some residential structures takes place by opening and closing of doors, pressure differential caused by wind velocity, removal of air from the structure due to the combustion of fossil fuel, and the fact that once the chimney and plenum chamber have been heated by the combustion process, there will be a pressure differential due to the stack effect of the cooling down of the plenum and the chimney. The house is divided into zones and the temperature in each zone is evaluated hourly, depending on the weather conditions at the building periphery, temperature fluctuations in adjacent spaces, and the environmental control systems operation. The load temperature calculation is described and the load calculation routines verified. (MCW)

00399 (NSF/RA/N—74-187) **Energy conservation research. Proceedings of the NSF/RANN conference, Airlie House, VA, February 18—20, 1974.** Lyday, N. (ed.). (National Science Foundation, Washington, D.C. (USA)). 1974. 194p. (CONF-740214—). Dep. NTIS (US Sales Only) $7.60.

From Conference on energy conservation research; Warrenton, Virginia, USA (18 Feb 1974).

The report contains the proceedings of the Conference on Energy Conservation Research, held at Airlie House, Warrenton, Virginia, February 18-20, 1974. The Conference brought together NSF/RANN energy conservation research grantees and representatives of user Federal agencies for an exploration of current energy conservation research. The major purposes of the Conference were to identify those research results that could have immediate application in achieving energy conservation, to assess research priorities in light of changing events and to identify potential areas for new research initiatives. Four major categories of research were discussed in workshops on (1) conservation in residential and commercial buildings; (2) conservation in the industrial sector; (3) conservation in the transportation field; and (4) cross-sector conservation studies. (auth)

SCHOOL

00400 (NSF/RA/N—74-123, pp 35-47) **Energy conservation in school buildings.** Rudoy, W. (Univ. of Pittsburgh, PA). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

A general analysis of energy use in schools and some case histories of specific programs for energy conservation are discussed. Space heating or the thermal environmental system was emphasized. Conservation measures that did not involve extensive construction changes were classified into four groups: heat loss reduction, controls and scheduling, maintenance and operation, and equipment modifications. The total for 38 schools for which data over a period of six months was available in the 1973 to 1974 school year shows a saving of 14.1% on total fuel and 15.6% on space heating only. Spot checks on electrical consumption also showed a reduction. With a substantial program for energy conservation, a reduction of 20% should not be too difficult, but further reductions will have to rely on major building and equipment modification and continued commitment to monitoring the energy conserving measures. (MCW)

00401 (NSF/RA/N—74-123, pp 121-124) **Retrofitting 35 buildings on the Ohio State University campus for energy conservation.** Sullivan, D. (Ohio State University, Columbus). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

The purchase of utilities at the university is $5,000,000 yearly with predictions indicating that this could double by 1980. These predictions were made before the Arab oil embargo, but it was evident then that fuel costs would increase. A program was undertaken to control and conserve the use of energy and to eliminate all unnecessary waste. The objectives of the initial program (pre-embargo) were to determine where and how energy is used and areas where energy waste can be eliminated or minimized; to develop the necessary controlling methods, monitoring and control systems required; and to accomplish detailed energy conservation studies on major energy-using building and systems to include such measures as heat recovery equipment. After completion of the surveys on the initial buildings of the program that started November 1, 1973, total savings in energy will average better than 30%. Funding of the program is briefly described. (MCW)

00402 (NSF/RA/N—74-123, pp 125-132) **Comparisons of energy use for the west campus of the Ohio State University, Columbus, Ohio.** Birdsall, B.E. (Ohio State University, Columbus). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

An assessment was made of energy consumption in Scott, Learning Resources Center, Bevis, and Rightmire buildings on the campus in an effort to reduce operating costs and save money. The effect of the differences in weather for comparison of the two operating periods (April through October for years 1972 and 1973) is graphically shown. The calculation method includes such parameters as the air conditioning system characteristics, weather, and conservation measures. The method has been checked against the data gathered for the ASHRAE study of the Legal Aids Building. The correlation of the method outlined in this report against actual measured data for the year 1972 was within two percent. (MCW)

00403 (NSF/RA/N—74-123, pp 133-143) **Retrofitting allied medical building for energy conservation.** Fuller, R.H. (Ohio State University, Columbus). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

A study was conducted in three stages of the Allied Medical facilities on the campus. The first stage was to review contract documents and confirm operations by tests and observations of the existing system. The tests were performed to establish actual air flow rates and motor amperage readings while a room survey showed individual space usage, lighting wattage, and occupancy. The second stage was to determine the gas and electric usage breakdown for the building. The third stage studied the initiation of unoccupied shutdown of the main building air handling systems. An accumulation of all data indicated a total yearly cost savings of $31,650 or 43 percent. It is concluded that an environmental system can be adapted precisely to actual requirements of space usage, and then result in improved comfort and reduced energy usage. (MCW)

COMMERCIAL

00404 (NSF/RA/N—74-123, pp 21-32) **Energy conservation in commercial buildings.** Jones, C.D.; McBride, M.; Dudley, J. (Ohio State Univ., Columbus). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

The development is reported of computer simulation methods for predicting heating and cooling load profiles using weather, structural, and architectural data as the input and energy consumption of the system with the load profile as the input. Detailed field measurements in the Ohio Legal Center, Columbus, verified the simulation methods. The total floor area in the three floors is 22,130 ft² of which 18,500 is conditioned by the central HVAC system. Approximately 22% of the wall area is glass. Parameters measured every 15 minutes were averaged hourly. Data are graphically presented for simulated and measured data and results are deemed satisfactory. Current studies, utilizing this

instrumented building, are directed towards determining the effects of various changes in system operations and control modes to identify various energy conservation methods. (MCW)

00405 (NSF/RA/N—74-123, pp 103-108) **Energy use patterns in large commercial buildings in New York City.** Lawrence, C.W. (New York City Administration, NY). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

Consolidated Edison, New York City's supplier of electricity and district steam, has not been able to meet peak demand conditions because of the lack of sufficient reliable electric and steam generating capability. The Interdepartmental Committee on Public Utilities was requested to optimize the electricity that would be available while new generating stations were being built, by determining how electricity was needlessly being used during peak demand days. Four general categories are supplied electricity, i.e., residential, commercial and industrial, railways, and public authorities. With commercial and industrial buildings requiring 55% of the total, an efficiency study was made of the large commercial office buildings. A summary of questionnaires from 180 real etate owners grouped the buildings into the number of stories, in increments of ten stories; total rentable floor area in increments of 100,000 square feet; and age in increments of five years. The data show that in a period of less than twenty years, total energy consumption per square foot has doubled. The relationship of energy consumed versus total net area of buildings or of building height does not show the classical trend one expects. A comparison was also made of energy consumption versus air conditioning means by steam or electric power. Results show that motive power for the air conditioning can have a large influence on energy consumption. (MCW)

TRANSPORTATION AND PROPULSION

00406 (UCRL—50028-75-1, pp 29-33) **Applied combustion research group.** Ross, M. 1975.

H-Division quarterly report, January—March, 1975.

A program to generate basic information on combustion processes that can be applied to improve the efficiency of stationary and mobile power plants and to develop new design concepts is described. Present-day computer technology and laser experimental diagnostic technology make it possible to study combustion processes that were previously inaccessible. Industry and an ERDA Laboratory will work together to develop experimentally verified computer simulations of combustion processes. A five-year program is planned, emphasizing advanced computational simulations, that will directly contribute to analysis and prediction of energy-conservation and pollution-control methods in combustion equipment. (RCK)

INDUSTRY

00407 (NSF/RA/N—74-123, pp 77-90) **Conservation of energy in our solid waste.** Moulenbelt, R. (Moulenbelt and Seifert, Consulting Engineers, Dayton, OH). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

The energy content in municipal solid wastes in the U. S. is the equivalent of approximately 80 million tons of coal per year. This is equal to the total tonnage used by all industry and about 15% of the total coal used in this country in 1970. Coal represents 20% of total energy requirements and municipal solid waste represents 3% of the total requirements. This percentage is about twice the power furnished by nuclear energy and about equal to the total furnished by hydroelectric power. Solid waste is self-renewing. Municipalities dispose of about 90% of this energy source, burn 8% in incinerators, and the remaining is recycled, composted, or fed to hogs. Utilization of solid wastes may be by waste heat recovery from combustion, use of refuse as a supplement fuel with coal, gas, or oil for steam and power generation, or production of gas, oil, and solid fuel substitutes for fossil fuels by means of pyrolysis. The composition of solid municipal wastes is described. Some processes at utilities being investigated or in operation are discussed. Utilizing the wastes as an energy source will be beneficial to the environment, will extend the life of available land-fill sites, and will recover valuable resources that would otherwise be destroyed. (MCW)

EQUIPMENT AND PROCESSES

00408 (NSF/RA/N—74-123, pp 53-62) **New look at boiler plant efficiency.** Hartman, W.L. (Ohio State Univ., Columbus). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

Engineers and managers formerly operated boiler plants for the maximum output for the dollar invested, and now total boiler plant efficiency is mandatory, or industry will be faced with mandated government regulations forcing changes in boiler plants. Familiar maintenance items are discussed that affect plant efficiency. A re-examination of the tax structure and the life-cycle cost of the entire boiler plant is recommended. If energy shortages reduce the usefulness or total capability of the facility, a new basis for boiler plant life-cycle costs is in order. Good public relations result from energy conservation and increased efficiency. The most compelling reasons for energy boiler plant efficiency are fuel resource conservation, aid to ecology, less dependence on foreign fuels, and economy. (MCW)

WASTE HEAT UTILIZATION

00409 (NSF/RA/N—74-123, pp 163-172) **Exhaust heat recovery systems.** Robinson, K.E. (112-B Silver Lake, Mears, MI). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

A program for the reduction of energy exhausted from industrial operations or buildings must be well organized with backing from management. A program for qualified engineers to follow when reducing or utilizing energy being discarded by the exhaust system is outlined. The plant heating systems must be studied to determine if it was properly engineered and installed to provide a satisfactory, controlled temperature in the occupied space. The quantity of air exhausted from the building must be reduced. The air being exhausted may be mixed with incoming air so as to raise its temperature to a suitable level. Air cleaning devices must be evaluated to determine if contaminated air now being exhausted may be recirculated. The possibility of utilizing the energy in contaminated air in production operations before it is exhausted was studied. If all other procedures are not applicable, the most suitable heat transfer device to incorporate into the exhaust system must be determined. (MCW)

ELECTRIC POWER

00410 (NSF/RA/N—74-123, pp 247-261) **Utilities and the energy crisis.** Shannahan, J.H.K. (Electric Energy Association, New York). 1974.

From Conference on energy conservation in commercial, residential and industrial buildings; Columbus, Ohio, USA (5 May 1974).

Proceedings of the conference on energy conservation in commercial, residential, and industrial buildings, Ohio State University, Columbus, May 5—7, 1974.

The energy crisis is viewed as real, not ending with the lifting of the Arab embargo, altering energy use patterns, continuing to elevate energy prices, and have long-range societal changes. Electric power consumption rates in the U. S. are summarized according to sector consumption. Energy sources for power generation are analyzed. The objectives of Project Independence are discussed and the availability of capacity, availability of electrical energy, and price are correlated with the aspects of the objectives. Problem areas are listed as determination of future growth rates, public understanding of high rates, availability of capital for expansion, and adjustment to revenue loss with conservation. The coal/nuclear economy is the predicted long-term trend. In short term, there will be adequate generating capacity but higher costs to consumers, spot shortages based on fuel supply problems, and conservation must be practiced. (MCW)

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

00411 (SAND—75-0255, pp 28-32) **Turbulence measurements in a motored internal combustion engine.** Witze, P.O. Aug 1975.

Sandia technology.

Turbulence structure, which influences fuel economy and emissions in internal-combustion engines, was investigated with hot-wire anemometry. (auth)

ALTERNATIVE FUELS

00412 (UCRL-Trans—10879) **On the trail of new fuels: alternative fuels for motor vehicles.** 2974. Translation of pp 1-282 from Neuen kraftstoffen auf der spur: alternative kraftstoffe fuer kraftfahrzeuge. 395p. Dep. NTIS $22.75.

A study is presented of motor vehicle alternate fuels which will alleviate the pollution and supply problems presented by the use of gasoline. Topics include: (1) an index of researchers; (2) properties of methanol and methyl fuel; (3) availability of the raw materials; (4) production of methanol; (5) ocean transport, storage, and inland distribution; (6) vehicle requirements and safety problems; (7) methanol operation of conventional vehicles; (8) methanol operation of other propulsion systems; (9) fuel cells and gas generators; and (10) a list of references. Likely prospects for alternate fuels are methanol in the short and intermediate term and hydrogen in the long term. For both these fuels, the manufacture does not depend on oil, combustion engines of known construction can be used, and these fuels can be substituted for gasoline in steps. (PMA)

MATERIALS

00413 (SAND—75-0328) **Progressive fracture model for brittle materials.** Yarrington, P. (Sandia Labs., Albuquerque, N.Mex. (USA)). Sep 1975. Contract AT(29-1)-789. 23p. Dep. NTIS $4.00.

Presented is a model of progressive fracture for brittle materials subjected to plane impulsive loading. The model is based largely on the two-dimensional Griffith theory of brittle fracture. Calculational results are presented for progressive fracture in an annulus of material subjected to an impulsive internal pressurization. The loading conditions and the geometry used in these calculations are similar to those that would be used to model a borehole explosion problem. (auth)

00414 (SAND—75-5610) **Error analysis of the flash thermal diffusivity technique.** Heckman, R.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1973. 21p. (CONF-750657—2). Dep. NTIS $4.25.

From 14. international conference on thermo-conductivity; Storrs, Connecticut, USA (2 Jun 1975).

An error analysis of the flash technique for thermal diffusivity measurements has been made by propagating errors in measured quantities through several data analysis techniques to determine the consequent errors in thermal diffusivity. The effects of extended pulse durations and of heat losses are considered. Results show that for most conditions actually encountered in experiments, relative measurement errors are reflected as relative errors of approximately the same size in the thermal diffusivity. (auth)

METALS AND ALLOYS

00415 (RDT-M—3-16T(8-75)) **Carbon and alloy steel pipe. (ASME SA-333 with additional requirements).** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development). Aug 1975. 7p. RSO .

This standard covers carbon and alloy steel pipe for nuclear and associated applications. The additional requirements include analysis, testing, examination, Charpy V-notch, etc. (DLC)

00416 (RDT-M—3-18T(8-75)) **Nickel-molybdenum-chromium alloy seamless tubes. (ASME SB-163 with additional requirements).** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development). Aug 1975. RSO.

This standard covers Ni—Mo—Cr alloy seamless tubes for nuclear and associated applications. The additional requirements and optional provisions include testing, examination, etc. (DLC)

00417 **Liesegang bands in internally oxidized AgCd-based ternary alloys.** Van Rooijen, V.A. (Universiteitscomplex Paddepoel, Groningen, Netherlands); Van Royen, E.W.; Vrijen, J.; Radelaar, S. *Acta Metall.*; 23: No. 8, 987-995(Aug 1975).

The origin of the occurrence of Liesegang band formation (periodic precipitation) during internal oxidation of AgCd alloys containing concentrations of Be, Mg, Al, or Y were investigated both experimentally and theoretically. A simple model of internal oxidation of ternary alloys is presented. The theory predicts band spacing as a function of temperature, Cd concentration, and concentration of the third element in good agreement with experimental results. (auth)

PREPARATION AND FABRICATION

00418 (BNL—20292) **Effect of metallurgical treatments on ac losses of Nb_3Sn produced by the solid state diffusion process.** Suenaga, M.; Bussiere, J.F.; Garber, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 15p. (CONF-750716—10). Dep. NTIS $4.00.

From International cryogenic materials conference; Kingston, Ontario, Canada (22 Jul 1975).

The metallurgical parameters varied were: Nb_3Sn formation temperature, heat treatment duration, Sn content of the Cu—Sn alloy matrix, and presence of Zr in the Nb cores. The 60-Hz losses can be made as low as 1 $\mu W/cm^2$ at current densities up to approximately 600 rms A/cm and approximately 100 $\mu W/cm^2$ at 1000 rms A/cm. To produce low losses, the heat treatment times should be short; Nb_3Sn growth rates should be fast; the Sn content should not be increased beyond the solubility limit; and 700°C rather than 800°C should be used. (DLC)

00419 (LA—6001-T) **Use of a general-purpose heat-transfer code for casting simulation.** Erickson, W.C. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. Contract W-7405-ENG-36. 158p. Dep. NTIS $7.60.

The practical use of numerical techniques in simulating casting solidification dictate that a general purpose heat transfer code be used and that results be obtained in an easy-to-analyze format. Color film plotting routines were developed for use with NASA's CINDA-3G heat transfer code; the combination of which meet the above criteria. The subroutine LQSLTR written for SINDA, the successor to CINDA-3G, was verified by comparing calculated results obtained using LQSLTR with those obtained using the specific heat method for handling the heat of fusion. Excellent agreement existed when similar data was used. When the more restrictive requirement of a 1°F melting range was used, comparable results were obtained. Uranium and lead rod castings were cast in instrumented graphite molds and the solidification sequence simulated using CINDA-3G. Discrepancies attributed to initial assumptions of instantaneous mold filling, uniform melt temperature, and intimate metal/mold contact were encountered. Further calculations using a model incorporating a gap between the mold and casting showed that the intimate contact assumption could not be used; a three-dimensional model also showed that the thermocouple assemblies used with the platinum—platinum-10 percent rhodium were a significant perturbation to the system. An L-shaped steel casting was simulated and the results compared to those reported in the literature. The experimental data for this casting were reproduced within the accuracy permitted by the thermal conductivity of the sand, thus demonstrating that agreement can be obtained when the mold material does not act as a chill. (auth)

00420 (LA-UR—75-804) **Preparation of high T/sup c/ Nb_3Ge superconductors by chemical vapor deposition.** Newkirk, L.R.; Valencia, F.A.; Wallace, T.C. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 10p. (CONF-750921—2). Dep. NTIS $4.00.

From 5. international conference on chemical vapor deposition; London, UK (22 Sep 1975).

Bulk layers of Nb_3Ge were deposited on copper substrates at 900°C by the hydrogen reduction of the chlorides of niobium and germanium with resistive T/sub c/'s as high as 22.5°K and current densities up to 1.8 x 10^6 amp cm^{-2} at 13.8°K. A detailed description of the coating process as well as empirical correlations between deposition parameters and T/sub c/ is given. Quantitative chlorination of Nb was found to be possible at T approximately equal to 250°C and for T greater than 900°C extending the range of delivery rates below those obtainable by powder feeding of

$NbCl_5$. Coatings in the range of 10 to 60 μm thick have been produced with a typical deposition efficiency of 50 to 65 percent for mass flow rates of the order of 1 g of salt per minute. The superconducting transition temperature has been correlated with a parameter of the form mole ratio x dilution x Reynolds number 0.22, where mole ratio is defined by moles Nb:moles (Ge + O) in the gas stream, and dilution by moles gas:moles salt. In addition, the relationship between mole ratio and dilution which determines the phase produced (Nb_3Ge or Nb_5Ge_3) is defined over the region of major interest. Lattice spacings are presented over a range of T/sub c/'s, and microstructure and substrate adherence are discussed. (auth)

00421 (SAND—75-0419) **Sandia Laboratories foundry practices in making aluminum alloy 535 (ALMAG 35) castings.** Cyrus, W.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Aug 1975. Contract AT(29-1)-789. 18p. Dep. NTIS $4.00.

The properties of Aluminum Alloy 535 are reported and discussed. The Sandia Laboratories foundry practices in casting Aluminum Alloy 535 are described. Some general mechanical data on the alloy are presented. Comparison of minimum requirements for as cast test specimens and for test specimens machined from castings are made. (auth)28478

00422 (Y-DA—6300) **Electroslag remelting of a uranium alloy.** Cadden, J.L.; Lewis, P.S. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 12 Jun 1975. Contract W-7405-eng-26. 28p. (CONF-750670—1). Dep. NTIS $4.50.

From Vacuum metallurgy conference; Columbus, Ohio, USA (23 Jun 1975).

A method for electroslag remelting (ESR) of a uranium alloy was developed which reduced the oxygen content from 200 to 300 ppM to less than 50 ppM. Slag compositions included acid grade CaF_2, reagent grade CaF_2, CaF_2-Ca and CaF_2-MgF_2 in ESR melting a uranium—7.5 wt percent niobium—2.5 wt percent zirconium alloy. Equipment and techniques were developed for dry slag starts and dry slag additions during melting. The effects of straight polarity versus reverse polarity were examined as well as the effectiveness of stirring. Microexamination of the slag after melting was made and the chemical composition was determined. The uranium alloy was also examined chemically and microscopically for the size and distribution of inclusions. A comparison of alloy segregation was made between vacuum arc remelted material by radiography. (auth)

00423 **Heat treatment of nickel alloys.** Smith, D.F. Jr.; Clatworthy, E.F. (to International Nickel Co.). US Patent 3,871,928. 18 Mar 1975. Filed date 13 Aug 1973. 10p.

A heat treating process is described that can be used to produce desired combinations of strength, ductility, and fabricability characteristics in heat resistant age-hardenable alloys having precipitation-hardening amounts of niobium, titanium, and/or tantalum in a nickel-containing matrix. (Official Gazette)

00424 **Electro-galvanic gold plating process.** Wright, R.R.; Wright, C.C.; Petit, G.S. (to U.S. Energy Research and Development Administration). US Patent 3,880,730. 29 Apr 1975. Filed date 21 Mar 1974. 4p.

PAT-APPL-453,480.

A gold plating arrangement is described that consists essentially of a plating bath containing 0.5 to 10 grams per liter lithium or potassium aurocyanide and 15 to 150 grams per liter ammonium chloride dissolved in water, and a base metal in contact with a second metal which occupies a higher position in the EMF series than gold or said base metal. The resultant plate is much denser than that obtainable by conventional electrolytic plating, thus serving as an effective corrosion protective surface against acid media. (auth)

00425 **Process for electroforming nickel containing dispersed thorium oxide particles therein.** Malone, G.A. (to Textron Inc.). US Patent 3,883,402. 13 May 1975. Filed date 10 May 1974. 14p.

Nickel electroforming is effected by passing a direct current through a bath containing a dissolved nickel salt or a mixture of such salts, such as those present in sulfamate or Watts baths, and finely divided sol-derived thorium oxide particles of 75 to 300 angstroms, preferably 100 to 200 angstroms diameters therein, at a pH in the range of 0.4 to 1.9, preferably 0.8 to 1.3. The nickel so deposited, as on a pre-shaped stainless steel cathode, may be produced in desired shape and may be removed from the cathode and upon removal, without additional working, possesses desirable engineering properties at elevated temperatures, e.g., 1,500 to 2,200°F. Although the material produced is of improved high temperature stability, hardness, and ductility, compared with nickel alone, it is still ductile at room temperature and has properties equivalent or superior to nickel at room temperatures up to 1,500°F. Further improvements in mechanical properties of the material may be obtained by working. Also disclosed are electrodeposition baths, methods for their manufacture, and products resulting from the electrodeposition process. (Official Gazette)

00426 **Coated air-stable cobalt—rare earth alloy particles and method.** Smeggil, J.C.; Charles, R.J. (to General Electric Co.). US Patent 3,892,601. 1 Jul 1975. Filed date 14 Mar 1974. 12p.

A process is described for producing novel air-stable coated particles of a magnetic transition metal-rare earth alloys. An organometallic compound which decomposes at a temperature below 500°C is heated to produce a metal vapor which is contacted with particles of a transition metal-rare earth alloy to deposit a metal coating on the particles. (Official Gazette)

00427 **Nb joined to alumina with Ni—Tl eutectic seal.** Purdy, D.L.; Williams, J.F. (to Arco Nuclear Co.). US Patent 3,897,223. 29 Jul 1975. Filed date 17 Oct 1974. 6p.

A metohod is described for joining members of copper and tungsten and members of copper and corrosion and/or temperature-resistant nickel-base alloys in the practice of which a mass of titanium is interposed between the members and the joint is heated to produce a eutectic of copper and titanium and then permitted to solidify. A like method is described for joining members of niobium and aluminium oxide in which a mass of nickel and titanium or of titanium alone are interposed between the members. Brazed assemblies are produced by the methods. A high-temperature resistant vacuum seal of niobium and aluminium oxide is formed. (auth)

00428 **Elevated temperature weldment behavior as related to nuclear design criteria.** King, R.T.; Canonico, D.A.; Brinkman, C.R. (Oak Ridge National Lab., TN). *Weld. J. (N.Y.)*; **54**: No. 8, 265s-275s(Aug 1975).

Factors affecting the physical and mechanical properties of weldments are reviewed. Data are presented that show wide variability in the properties of weld metal and heat-affected zones both within a given weldment and from weldment to weldment. The weld metal or heat-affected zone may be stronger or weaker, and more or less ductile than the base metal joined. This implies that current design rules, which are presumed to have well-known safety factors based on the properties of base metals, may have other actual safety factors in welded construction, due to the differences between weld metal and base metal properties. Suggestions for obtaining further data that can subsequently be used to improve confidence in design rules or to change design rules for nuclear application are presented. (auth)

00429 **Modelling of rearrangement processes in liquid phase sintering.** Huppmann, W.J.; Riegger, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). *Acta Metall.*; **23**: No. 8, 965-971(Aug 1975).

Tungsten spheres of uniform size were coated with copper. Planar arrays of these particles were presintered and then heated above the melting point of copper for four minutes. By direct comparison of the presintered and the liquid phase sintered condition the movements of individual particles could be measured as a function of the amount of liquid, wetting angle, and packing density. Melt bridge formation between adjacent particles in densely packed arrays can be understood on the basis of calculations in which the force acting between two particles is computed as a function of the interparticle spacing. The shrinkage by rearrangement processes in randomly packed arrays is also a function of the capillary forces acting in these melt bridges, however, at the same time strong evidence is presented for intrinsic forces acting in such a way as to impede densification in an array of powder particles. (9 fig) (auth)

00430 **Hot workability of Nimonic 115 as a function of strain rate.** Cederblad, N. (Aktiebolaget Atomenergi, Uddeholm, Sweden); Grant, N.J. *Metall. Trans., A*; **6A**: No. 8, 1547-1552(Aug 1975).

The hot workability of Nimonic 115 was studied by means of very high strain rate stress rupture tests in the temperature interval 1323 to 1473°K at strain rates of 10^{-4} to 10 per s. Hot plasticity, measured as elongation and reduction of area at fracture, increased generally with decreasing strain rates. Maximum values of about 40 percent elongation and 70 percent reduction of area were obtained between 1398 to 1448°K for strain rates below about 1 per s. For higher rates of strain than about 1 per s, ductility at fracture fell sharply. Ductility above 1448°K was poor at all strain rates and fell to a minimum at 1473°K regardless of strain rate. The highest ductility values are associated with intermediate temperatures and intermediate strain rates where conditions are optimum for significant recovery without encountering grain growth. The presence of excess phases leads to severe intergranular embrittlement at the highest temperatures and strain rates. (auth)

STRUCTURE AND PHASE STUDIES

00431 (COO—3476-11) **Interstitial impurity interactions and dislocation microdynamics in Mo crystals.** Kwok, D.N. (State Univ. of New York, Stony Brook (USA). Dept. of Materials Science). May 1975. Contract AT(11-1)-3476. 109p. Dep. NTIS $8.50.

Thesis.

The effects of interstitial impurities on the mechanical properties of molybdenum are explored by comparing results obtained for crystals of various interstitial contents controlled by ultra-high vacuum outgassing. Results show a modulus reduction for as-grown samples and for outgassed specimens at low applied stresses. As a function of plastic microstrain, the values of modulus defect for both as-grown and outgassed specimens saturate at the same value. Interstitial impurities act as pinning agents to dislocation bowing, but when all the easy dislocation loops have broken away from local interstitial pins, the modulus defect reaches a constant saturation value. Etch pitting techniques were used to correlate microstrain observations with dislocation generation and motion. It has been found that edge dislocation generation and movement are active in the microstrain region while screw dislocations are relatively inactive until the macrostrain region is reached. Dislocation velocities range from 10^{-6} to 10^{-3} cm/s and the average distance between interstitial impurity pinning points is found to be approximately 8 x 10^{-4} cm. (auth)

00432 (Y—1978) **Niobium in tungsten-3.5 nickel-1.5 iron alloy.** Ludwig, R.L. (Oak Ridge Y-12 Plant, Tenn. (USA)). 15 Aug 1975. Contract W-7405-eng-26. 19p. Dep. NTIS $4.00.

Tungsten—3.5 nickel—1.5 iron alloy normally possesses a high degree of tensile ductility and can be liquid-phase sintered in dry hydrogen. When prepared with tungsten from certain sources, the alloy may become brittle or develop surface blisters during sintering. The addition of niobium in concentrations of 200 to 2000 parts per million to alloys susceptible to these difficulties has served to overcome the embrittlement and sintering problems. Excessive quantities of niobium, however, tend to deteriorate the tensile properties of the alloy. (auth)

00433 (Y—1984) **Study of the retention of metastable phases in quenched uranium—niobium—zirconium ternary alloys.** Cooper, R.H. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 43p. Dep. NTIS $4.00.

A metastable or transitional phase diagram for the uranium-rich section of the U—Nb—Zr ternary system was proposed for alloys quenched from 850°C. A review of those alloys having a bcc and a displaced bcc structure revealed a linear relation between the bcc lattice parameters and alloy content, which approximately obeys Vegard's Law over the range of compositions investigated. The monoclinic angle, γ, was found to be linearly related to the Nb and Zr contents. Metallographic examination of the samples having a monoclinic structure indicated that these samples had a Widmanstatten structure. The DPH hardness of all alloys regardless of crystal structure was found to be related to the niobium and zirconium contents by the following equation: DPH = 44.9 + 0.45 Nb^2 + 8.8 Zr. (25 figures) (auth)

00434 **New etch for liquid metal fast breeder reactor materials.** Bender, J.H.; Baker, C.; Johnson, K.A. (Los Alamos Scientific Lab., NM). pp 187-195 of **Microstructural science. Volume 2.** Fritzke, G.P. (ed.). New York; American Elsevier Publishing Company, Inc. (1974).

From 6. meeting of International Metallographic Society of America; Los Angeles, California, USA (25 Sep 1973).

See CONF-730973—.

Etchants for irradiated uranium plutonium mixed oxide experimental fast breeder reactor fuels have been various combinations of H_2O, HNO_3, HF, $CeNO_3$, H_2O_2 and H_2SO_4. These etches have not been entirely satisfactory in delineating the grain structure and grain boundaries of irradiated (U, Pu)O_2. In addition these usual oxide etches destructively attack some areas of the irradiated (U,Pu)O_2 fuel. Irradiated oxide fuel usually contains a number of types of microstructures and a variety of compositions because of thermal and fission product gradients. A hydrobromic acid etch composed of (10ml HCL, 10ml HBr, lml HF), when applied to irradiated (U, Pu)O_2 fuel does not destroy any of the structures present, but the etch does clearly delineate all fuel regions. Removal of the hydrobromic etch for electron microprobe examination or as-polished reviewing of the sample is accomplished by lightly polishing the sample surface and does not necessitate extensive repolishing procedures. When the hydrobromic etch is applied to irradiated stainless steel and Incoloy 800 cladding the carburized regions, reaction zones and the recoil region are more clearly delineated than with previously used chemical or electrolytic etches and again without the detrimental effects of water and electrolysis on the accompanying fuel specimen. (auth)

00435 **Kinetics of precipitation of carbon in molybdenum at about 250°C.** Yoshioka, K. (Tohoku Univ., Japan); Kimura, H. *Acta Metall.*; **23**: No. 8, 1009-1015(Aug 1975).

The kinetics of the precipitation are studied in detail by resistivity measurements. The rate of this precipitation stage is controlled by the diffusion of carbon atoms. The activation energy for carbon diffusion at this temperature range is determined to be 1.2 eV, which is appreciably smaller than the activation energy reported so far for carbon diffusion measured at high temperatures, about 1.7 eV. (auth)

MECHANICAL PROPERTIES

00436 (HEDL-TME—73-34) **Effect of chemistry variations on the tensile properties of 20% cold worked 316 stainless steel.** Paxton, M.M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Mar 1973. 31p. Dep. NTIS $4.75.

The effect of alloy compositional variations on the 1400°F tensile properties of 20 percent cold worked type 316 stainless steel was determined. Forty-five different alloys were used with compositional variations in carbon, nitrogen), phosphorus, sulphur, boron, manganese, copper, silicon, molybdenum, cobalt, chromium, and nickel. The 0.2 percent yield strength varied linearly over certain compositional ranges for single elements. By assuming no interaction parameters, the 0.2 percent yield strength for any specific composition can be calculated by a simple summation. A multiple linear regression computer code yields the following equation: 0.2 percent yields stress = 49,842 + 3258 (percent molybdenum) — 57054 (percent carbon) — 1307 (percent copper) + 42112 (percent nitrogen) + 2788 (percent silicon) + 790 (percent cobalt) — 670 (percent chromium). (auth)

00437 (LA-UR—75-1189) **Fracture behavior of a Pt—30% Rh—8% W alloy between room temperature and 1300°C.** Rohr, D.L.; Hecker, S.S. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. 21p. (CONF-750650—1). Dep. NTIS $4.25.

From 4. international colloquium of group theoretical methods in physics; Nijmegen, Netherlands (23 Jun 1975).

Pt—30 percent Rh—8 percent W alloys are being considered for structural applications in Radioisotopic Thermoelectric Generators (RTGs) for space nuclear power systems. To determine materials compatibility and structural properties thermally exposed tensile specimens were tested at temperatures between 23 and 1300°C. The specimens had been exposed as control specimens or in contact with graphite or $^{238}PuO_2$ (the radioisotopic fuel) at 900 and 1100°C for 2000 and 8000 h. The fracture behavior was brittle and intergranular below 250°C and between 900 and 1100°C, and ductile transgranular at 250 to 800°C and above 1100°C. Auger Electron Spectroscopy of freshly fractured specimens revealed segregation of phosphorus up to 11 atomic percent at the grain boundaries which appears to be responsible for the low temperature brittle fracture. Exposure to $^{238}PuO_2$ further embrittled this alloy at low temperatures. The high temperature brittle fracture behavior resembled that caused by liquid metals. (auth)

00438 (LA-UR—75-1415) **Effect of strain rate on the tensile properties of α- and delta-stabilized plutonium.** Hecker, S.S.; Morgan, J.R. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 13p. (CONF-750915—11). Dep. NTIS $4.00.

From 5. international conference on plutonium and other actinides; Baden-Baden, F.R. Germany (10 Sep 1975).

The tensile properties of unalloyed α-Pu and 3.4 at. percent Ga-stabilized delta-Pu were determined at strain rates from 10^{-5} to 100/s. Tests at strain rates less than 10^{-2}/s were conducted on an Instron Testing Machine; those at strain rates between 10^{-2} and 3/s on a closed-loop electrohydraulic MTS system; and those at strain rates greater than 3/s on a specially modified Charpy Impact Tester. Three lots of delta-Pu, one rolled and annealed and the other two cast and homogenized, were tested. The 0.2 percent yield strengths and ultimate tensile strengths increased by an average of 5.2 and 6.0 MPa per factor of 10 increase in strain rate. This increase was achieved without penalty in tensile ductility as measured by total elongation to fracture and by reduction in area. The isostatically pressed α-Pu specimens also showed a large increase in fracture stress with strain rate (34.3 MPa per factor to 10 increase in strain rate). The fracture was macroscopically brittle (plastic strains less than 0.3 percent) although we observed extensive evidence of microscopic flow in the ductile dimple-type appearance of the fracture surfaces. The strain to fracture appeared to exhibit a minimum at a strain rate of 10^{-3}/s. (auth)

00439 (LBL—3794) **Investigation of ultra-high strength Fe/4Cr/0.4C martensitic steels for improved toughness.** Rao, B.V.N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. Contract W-7405-ENG-48. 87p. Dep. NTIS $7.50.

Thesis.

Intergranular cracking in the as-quenched structures of vacuum melted Fe/4Cr/0.4C steel was investigated in terms of the heat treatment conditions. It was shown that the amount of carbon in solution and the martensite packet size are the two most important factors influencing cracking tendency. Non-conventional double heat-treatments have been designed in order to take advantage of higher austenitizing temperature and fine austentite grain size. These involved high temperature (greater than or equal to 1100°C) austenitizing during the first solution treatment followed by either interrupted quenching (M/sub s/-M/sub f/ range) or isothermal transformation to produce lower bainite and a subsequent 900°C grain refinement treatment to produce quench crack-free microstructures. Transmission and scanning electron microscopy and optical microscopy were used to characterize the microstructure. Tensile, CVN impact energy and plane strain fracture toughness tests were conducted to document the mechanical properties. The effects of substructural twinning, undissolved carbide morphology, auto-tempering and retained austenite on toughness properties are discussed to explain the observed variation in mechanical properties with heat-treatment. (LK)

00440 (LBL—3914) **Deformation behavior of an idealized crystal.** Altintas, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1975. Contract W-7405-ENG-48. 51p. Dep. NTIS $5.75.

Thesis.

The deformation behavior of an idealized crystal made by stacking of parallel slip planes is studied. Each slip plane is assumed to contain active sources of dislocations leading to a constant density of non-interacting dislocations in the plane which glide through randomly distributed localized point obstacles, representing small precipitates. The dislocation is assumed to have a constant line tension and the dislocation—obstacle interaction is taken to have a simple step form. Using results of computer simulation of thermally activated glide through random arrays of point obstacles, the deformation is modeled as a function of temperature and applied stress, determining the strain rate and the morphological characteristics of slip. Stress-strain rate and flow stress-temperature relations are discussed. (auth)

00441 (ORNL-TM—4992) **Correlation and extrapolation of creep ductility data for four elevated temperature structural materials.** Booker, M.K.; Brinkman, C.R.; Sikka, V.K. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 34p. Dep. NTIS $4.00.

The amount of deformation that a component can successfully endure without incurring failure-inducing damage can be a useful limit in elevated temperature design. Treatment of experimental creep ductility data by a parametric analysis technique allows the prediction of such limits. Application of such a method to data for various ductility indices for four elevated-temperature structural materials is presented, including a discussion of the results. Materials studied include types 304 and 316 stainless steel, 2¼ Cr-1 Mo steel, and Inconel Alloy 718. (10 tables, 16 figures) (auth)

00442 (ORNL-TM—4997) **Interrelationships between creep life criteria for four nuclear structural materials.** Booker, M.K.; Sikka, V.K. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 22p. AT.

Current elevated-temperature nuclear system design rules require consideration of the time to the onset of tertiary creep as one factor in the determination of design allowable stress intensity limits. However, tertiary creep data are often scarce, and little work has been done in their analysis. It is shown here that time to tertiary creep data may be analyzed by the same parametric techniques that were developed for treating rupture life data. Also, time to tertiary creep, t_3, is expressed as a function of rupture life, t/sub r/, by $t_3 = At/sub\ r/\beta$, where A and β are material constants. Comparisons between these two prediction methods show that they produce similar results. (auth)

00443 (ORO—3262-41) **Static strain aging in nickel 200. Progress report, 1 December 1974—30 November 1975.** Reed-Hill, R.E.; Cribb, W.R. (Florida Univ., Gainesville (USA). Engineering and Industrial Experiment Station). 1975. Contract At(40-1)-3262. 121p. Dep. NTIS $9.25.

Static strain aging tests were conducted on annealed tensile specimens prestrained at 273°K to a stress level of 265 MPa (approximately 0.05 strain) at a nominal strain rate of 4.2×10^{-3} s^{-1} (homogeneous plastic flow). Specimens were aged immediately after prestraining for different times at 373, 408, 428, 448, or 473°K and the time dependence of the return of the lower yield stress was observed. Δsigma increased as ln t or approximately as $t^{1/7}$ kinetically and had an activation energy of 25 kcal/mole before the observed peak in Δsigma. The defect responsible for this anomalous increase in Δsigma may be the rotation of carbon—vacancy pairs in the strain fields of dislocations. A quantitative model is derived for the increase in Δsigma before the aging peak and it is concluded that several important stages in the aging of Nickel 200 may occur: (a) the formation of carbon—vacancy pairs and their initial ordering, (b) the migration of vacancies in the strain energy gradients of dislocations and the consequent formation of more carbon—vacancy pairs near dislocations, (c) the growth of an ordered carbon—vacancy dipole atmosphere, (d) depletion of free vacancies in the remainder of the lattice which decreases the flux to the ordered atmosphere and results in a Δsigma maximum, (e) the migration of bound vacancies to dislocation sinks and the resulting decrease in Δsigma, (f) the migration of carbon atoms in the strain fields of dislocations and the growth of a Cottrell atmosphere, and (g) precipitation of graphite during overaging. (Items (f) and (g) are only speculated to occur.) This model is different from the Cottrell—Bilby model and can account for the kinetics and activation energy for strain aging observed in Nickel 200. (auth)

00444 (RD/B/N—3421) **Proposed materials test piece design to derive the plane strain fracture toughness.** Neale, B.K. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1975. 19p. Dep. NTIS (US Sales Only) $4.00.

A method is presented for determining the relevant dimensions of a compact tension specimen necessary to derive the plane strain fracture toughness of a material. Comparison of this method with currently accepted practices enables a considerable reduction in the specimen size to be made. The report is concluded with a recommended experimental test procedure to be used with the analysis given here for deriving the plane strain fracture toughness. (auth)

00445 (SAND—75-0255, pp 5-9) **Fracture control in high-toughness materials.** Hickerson, J.P. (Westinghouse Research Labs., Pittsburgh). Aug 1975.

Sandia technology.

A new concept of material fracture has led to a valid general criterion for predicting failure levels in different loading geometries for many alloys. (auth)

00446 (ORNL-tr—4011) **Formation of deformation bands in rolled copper single crystals.** Heye, W.; Sattler, H.P. Translated by R.G. Mansfield from *Z. Metallkd.*; 62: No. 5, 386-391(1971). 11p. Dep. NTIS $4.00.

Copper single crystals with different initial orientations were rolled and the splitting into deformation bands was observed. Crystals whose orientations are (001) [110] and (111) [01 anti 1], in particular, lend themselves to demonstrate the mechanism and the cause of the splitting into deformation bands. (auth)

00447 **Effects of helium on the high temperature creep and fracture properties of Ni—6% W.** Matlock, D.K.; Nix, W.D. (Stanford Univ., Calif. (USA). Dept. of Materials Science and Engineering). *J. Nucl. Mater.*; 56: No. 2, 145-152(May 1975).

High-temperature constant true stress creep tests were performed on samples of Ni-6 percent W, which were injected with α particles to calculated helium concentrations of 0.4 and 4.0 ppM. The apparent activation energies for creep were determined to be between 260 kJ/mol at 20.7 MPa and 364 kJ/mol at 48.2 MPa and were found to be greater than 247 kJ/mol, the activation energy for creep in similar samples that did not contain helium. These high activation energies for the injected material are believed to be fictitious in the sense that they are caused by the effects of helium on the shape of the creep curve. The helium bubbles present at grain boundaries promote premature fracture early in the primary creep stage by lowering the effective fracture-surface energy and thereby prevent the observation of steady-state creep in the injected material. (auth)

00448 **Thermo-mechanical treatment of zirconium alloys.** Levy, I.S. (to Exxon Nuclear Co., Inc.). US Patent 3,884,728. 20 May 1975. Filed date 26 Feb 1973. 10p.

A zirconium alloy comprising at least 95 percent Zr (Zircaloy), which has been thoroughly annealed, is greatly increased in strength without substantial loss in ductility by subjecting it to tensile creep deformation in a temperature range in which creep will occur, yet which is below the temperature for significant recovery. (Official Gazette)

00449 (ORNL-tr—4016) **Yield surfaces after various types of preloading. Part 1. History and present status of its development.** Ikegami, K. Translated by H. Kubota from *Zairyo*; 24: 491-504(Jun 1975). 7p. Dep. NTIS $4.00.

The theoretical and experimental studies conducted in the past on the plasticity rules for metals are discussed from the standpoint of phenomenological observations by comparing the various

proposals with the attempts at verification. An overall view of the trends in these two lines of research is described. A review of the research on yield surfaces is also presented, and comparisons and discussions of the shape of yield surfaces, after preloading had been applied by various methods, are made. (auth)

00450 Relationship between rupture life and creep properties of 2 1/4 Cr—1 Mo steel. Klueh, R.L. (Oak Ridge National Lab., TN). *Nucl. Technol.;* **26**: No. 3, 287-296(Jul 1975).

Several investigators have demonstrated empirical relationships between creep and rupture properties for various metals and alloys. Empirical relationships between the rupture life, the minimum creep rate, and the time to the end of steady-state creep (start of tertiary creep) for four heats of normalized-and-tempered $2^1/_4$ Cr—1 Mo steel with different carbon contents were examined. The primary objective was the determination of the conditions that affect the correlation. The following relationships were obeyed: t/sub r/ = C/epsilon/sub s/ and t_2 = F/sub s/t/sub r/, where t_2 is the time to start tertiary creep, t/sub r/ is the rupture life, epsilon/sub s/ is the steady-state creep rate, and C and F/sub s/ are constants. The primary microstructural constituent (proeutectoid ferrite or bainite) of the matrix and the precipitates present in that matrix (before test or formed during test) played a significant role in the correlation of the data with the empirical relationships. (auth)

00451 Influence of heat treatment on the fatigue crack growth rates of a secondary hardening steel. Horn, R.M. (Univ. of California, Berkeley). *Metall. Trans., A;* **6A**: No. 8, 1525-1533(Aug 1975).

The relationships between microstructure and fatigue crack propagation behavior were studied in a 5Mo—0.3C steel. Microstructural differences were achieved by varying the tempering treatment. The amounts, distribution, and types of carbides present were influenced by the tempering temperature. Optical metallography and transmission electron microscopy were used to characterize the microstructures. Fatigue fracture surfaces were studied by scanning electron microscopy. For each heat treatment the fatigue crack growth properties were measured under plane strain conditions using a compact tension fracture toughness specimen. The properties were reported using the empirical relation of Paris [da/dN = $C_o\Delta K$/sup m/]. It was found that secondary hardening did influence the fatigue crack growth rates. In particular, intergranular modes of fracture during fatigue led to exaggerated fatigue crack growth rates for the tempering treatment producing peak hardness. Limited testing in a dry argon atmosphere showed that the sensitivity of fatigue crack growth rates to environment changed with heat treatment. (auth)

00452 Explosive strengthening of a Cu—Be alloy. Nordstrom, T.V.; Rohde, R.W.; Mottern, D.J. (Sandia Labs., Albuquerque, NM). *Metall. Trans., A;* **6A**: No. 8, 1561-1568(Aug 1975).

The effects of shock loading on the mechanical properties and microstructure of a precipitation hardening copper 1.91 wt percent beryllium alloy were studied. Sheet samples suitable for tensile testing were explosively loaded to pressures of 10, 20, 30, 40, and 50 GPa. Subsequent tensile tests were performed on samples in the as-shocked and shocked plus aged conditions. Their properties are compared to those of material deformed by cold rolling and aged after cold rolling. The mechanical strength in the as-shocked condition increases linearly with pressure. The strength of the shocked plus aged material also increases with shock pressure but at a slower rate. Unaged material shocked to 50 GPa has a higher yield strength than material cold rolled 37 percent. However, the cold rolled material responds better to aging. In the aged condition, 37 percent cold rolled material is stronger than the material shocked to 50 GPa. Transmission electron microscopy reveals the onset of deformation twinning between 10 and 20 GPa. The volume fraction of twins and the dislocation density both increase with increasing shock pressure. The results indicate that deformation twinning has little significant strengthening effect in this system and that yield strength increases can be accounted for on the basis of increasing dislocation density. (auth)

00453 Dynamic strain aging of metastable beta titanium alloys. Rack, H.J. (Sandia Labs., Albuquerque, NM). *Scr. Metall.;* **9**: No. 8, 829-831(Aug 1975).

Two Ti alloys were studied: RMI 38644 (3.4 Al, 8.3 V, 5.8 Cr, 3.9 Zr) solution treated at 927°C, and Beta-III (10.2 Mo, 5.8 Zr, 4.7 Sn) solution treated at 732, 787, 871, or 982°C. Serrated yielding appeared at 200°C and above for Beta-III solution treated at 982°C; no such serrations were observed for RMI 38644 above 260°C. Load/stress drop associated with dynamic yielding increased with temperature for both alloys. Results indicate a β—ω transformation mechanism in Beta-III and a dislocation—interstitial interaction mechanism in RMI 38644. (DLC)

00454 Thermal equilibria and mechanical stability of Ti_3Al phase in Ti—Mo—Al alloys. Hamajima, T. (Univ. of Bochum, Ger.); Weissmann, S. *Metall. Trans., A;* **6A**: No. 8, 1535-1539(Aug 1975).

The phase diagram of the isopleth section of the Ti—7 at. percent Mo—Al system was improved and expanded to include alloys up to 25 at. percent aluminum. The mechanical and thermal stability of alloys aged in the two-phase region, $\beta + Ti_3Al$, was correlated to the microstructure. X-ray rocking-curve studies of the polycrystalline specimens showed that after 2 percent deformation of a Ti—7 Mo—16 Al alloy the β matrix became preferentially plastically deformed, while the Ti_3Al particles functioned as hard particles undergoing little lattice distortions. (auth)

00455 High-temperature strength and ductility increases of Ti—Mo—Al alloys by step aging. Hida, M. (Okayama Univ., Japan); Weissmann, S. *Metall. Trans., A;* **6A**: No. 8, 1541-1546(Aug 1975).

Step-aging programs, based on principles of particle-dislocation interactions, were developed systematically to obtain increases in the high-temperature strength and ductility properties of Ti—7 at. percent Mo—Al alloys. A triple-step aging program applied to Ti—7 Mo—16 Al produced a yield stress $\sigma_{0.2}$ = 1,500 MN/m², elongation to fracture epsilon/sub F/ = 4 percent at room temperature, and $\sigma_{0.2}$ = 900 MN/m², epsilon/sub F/ = 12 percent at 600°C. A two-step aging program resulted in $\sigma_{0.2}$ = 1,350 NM/m², epsilon/sub F/ = 5 percent at room temperature; $\sigma_{0.2}$ = 800 MN/m², epsilon/sub F/ = 20 percent at 600°C. (auth)

00456 Age hardening characteristics of Nb-base alloys containing carbon and/or silicon. I. (Nb—15 at. % Hf). Birla, N.C. (Univ. of Cincinnati); Hoch, M. *Metall. Trans., A;* **6A**: No. 8, 1631-1643(Aug 1975).

A study was made to investigate solutioning and aging reactions, and their effects on microstructure and microhardness, in fifteen experimental Nb-base alloys, involving Nb—C, Nb—Si—C, Nb—Si, Nb—15 Hf, Nb—15 Hf—C, Nb—15 Hf—C—Si, and Nb—15 Hf—Si systems. Alloys were solution treated, quenched, then aged for 2 h at temperatures ranging from 800 to 1600°C, to examine the effect of temperature, and aged at 900 to 1100°C isothermally for times varying from 2 to 20 h. Hardness provided the means of evaluating structural effects. Microstructural changes were determined by optical and electron microscopy, and the phases were chemically extracted and identified by x-ray diffraction or electron diffraction. In general, all of the alloys containing hafnium exhibited age hardening characteristics. This age hardening appears to be due to precipitation of the complex monocarbide (Nb,Hf)(C,O,N) phase. Replacement of some of the carbon by silicon in the Nb—15 Hf—C alloy raises the overaging temperature from 800 to 1000°C and leads to strength retention for longer times as compared with the alloys which contain carbon only. Out of several alloys studied, the Nb—15 Hf—0.46 C—2.32 Si and Nb—15 Hf—1.31 C—0.96 Si showed the best aging characteristics. (auth)

00457 Age hardening characteristics of Nb-base alloys containing carbon and/or silicon as interstitials. II. (Nb—33 at. % Hf). Birla, N.C. (Univ. of Cincinnati); Hoch, M. *Metall. Trans., A;* **6A**: No. 8, 1645-1652(Aug 1975).

A study was made to investigate the solutioning and aging reactions and their effects on microstructure and microhardness in nine experimental Nb-base alloys involving Nb-33Hf, Nb-33Hf-C, Nb-33Hf-Si, and Nb-33Hf-C-Si systems. Alloys were solution treated, quenched, then aged for 2 h at temperatures ranging from 800 to 1600°C to examine the effect of temperature, and aged at 900 to 1100°C isothermally for times varying from 2 to 20 h. Microstructural changes were determined by optical and electron microscopy, the phases were chemically extracted and identified by x-ray diffraction, and hardness provided the means of evaluating structural effects. The Nb-33Hf-Si and Nb-33Hf-C-Si alloys exhibited age hardening characteristics, which appear to be due to the precipitation of complex monocarbide (Nb, Hf)(C, O, N), while Nb-33Hf-C alloys showed separation of Nb_2C phase from (Nb, Hf)(C, O, N) on aging. (auth)

PHYSICAL PROPERTIES

00458 (BNL—19798) Effect of metallurgical treatments on ac losses of Nb_3Sn by solid state diffusion process. Suenaga, M.; Garber, M.; Bussiere, J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 12p. (CONF-750716—2). Dep. NTIS $4.00.

From International cryogenic materials conference; Kingston, Ontario, Canada (22 Jul 1975).

It has been shown that ac losses in Nb_3Sn properly prepared can be made as low as other heat sources, such as dielectric and radiation losses, in a transmission line. One method for making low loss Nb_3Sn is by a solid state diffusion process, where Nb_3Sn is

formed at a Nb—(Cu– Sn) alloy interface. Effects of various metallurgical treatments on ac losses of Nb_3Sn made by this process are reported, and the importance of surface conditions as well as bulk critical current densities, J/sub c/, in relation to the losses is discussed. (DLC)

00459 (CALT—822-75) **Superconducting copper-base alloy containing filaments of V_3Ga.** Chen, W.Y.K.; Tsuei, C.C. (California Inst. of Tech., Pasadena (USA). W.M. Keck Lab. of Engineering Materials). Jul 1975. Contract AT(04-3)-822. 22p. Dep. NTIS $4.25.

The preparation and the properties of copper-rich superconductors containing filaments of V_3Ga are described. The superconducting transition temperature is about 13°K. The critical current density at zero field and 4.2°K is as high as 2.9 x 10^4 A/cm² and decrease to 2 x 10^3 A/cm² at 60 kG. (auth)

00460 (COO—3429-26) **Thermal, structural and magnetic studies of metals and intermetallic compounds. Annual report, 15 May 1974—15 May 1975.** Wallace, W.E.; Rao, V.U.S. (Pittsburgh Univ., Pa. (USA). Dept. of Chemistry). 1 Jun 1975. Contract E(11-1)-3429. 59p. Dep. NTIS $6.00.

The odd magnetic properties of Y_6(Fe/sub 1-x/Mn/sub x/)$_{23}$ ternaries were studied. Magnetic studies of Th(Co/sub 1-x/Ni/sub x/)$_5$ ternaries show strong magnetic anisotropy in $ThCo_5$ originates with the Co in the 2c sites. Efforts were made to effect a change of coupling in rare earth-transition metal systems, using alloys doped with Ca or Ag to lower electron concentration. The effect of Ca on magnetic properties is being studied. Results on Pr/sub 1-x/Ca/sub x/Al_2 indicate that ferromagnetic $PrAl_2$ becomes metamagnetic when Pr is partially replaced by Ca. Numerous ternaries of the formula RT_2X_2 (R = a rare earth, T = a 3d transition metal or metals and X = Ge or Si) were prepared and studied magnetically. Magnetic properties of various Yb-Co binaries were determined. Heat capacity data on Dy_3Al_2 and DyNiCo are reported. H_2 absorption and desorption studies on the RT_2 systems (T = Fe or Co) and on Tb_6Co_7 were made at several temperatures. From the temperature coefficient of these measurements the heats of solution were determined. These range from about 9 to 10 kcal per mole of hydrogen. Pulsed field gradient NMR equipment has been readied to determine the mobility of H in rare earth intermetallics. (JRD)

00461 (COO—3446-1) **Model pseudopotentials and atomic properties of simple metals and alloys. Final progress report, 1 August 1975.** Welch, D.O. (Princeton Univ., N.J. (USA). Dept. of Aerospace and Mechanical Sciences). 1975. Contract AT(30-1)-4198. 22p. Dep. NTIS $4.25.

A theoretical investigation was made of impurity—vacancy binding and impurity diffusion by the mechanism of vacancy motion. Calculations were made of the impurity—vacancy binding energy and impurity migration energy in simple metals using model pseudopotentials. Several model potentials and dielectric functions were used and the sensitivity of the results to the parameters of the models explored. (DLC)

00462 (KAPL-M—7412) **Excess entropy for a vacancy in a crystal.** Brudnoy, D.M. (Knolls Atomic Power Lab., Schenectady, N.Y. (USA)). Apr 1975. 46p. Dep. NTIS $5.50.

The excess entropy for a single vacancy in any crystal with cyclic boundary conditions is given, within the small perturbation approximation, by ΔS/k/sub B/ = d/2, independent of crystal structure and particle interaction, dependent only on the dimensionality of the crystal, d. It is argued that the effect of free surface boundary conditions on ΔS, within an exact theory, for any localized defect (not only a vacancy), is negligible. Using the vacancy perturbation result for ΔS and Lawson's formula, a value for the vacancy formation volume is obtained only in terms of known measured parameters. If localized vibrational modes are present due to the vacancy, what effect these might have on ΔS, and, from this, what materials might be candidates for observing these localized modes are discussed. (auth)

00463 (LA-UR—75-750) **Observations of asymmetry effects in the velocity of destruction of superconductivity by current in Type II Ta wires.** Overton, W.C. Jr.; Weinstock, H.; Schuch, A.F. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-750811—2). Dep. NTIS $4.00.

From 14. international conference on low temperature physics; Leiden, Netherlands (14 Aug 1975).

The results of experiments on type-II Ta wires of 0.0254 cm diameter immersed in a liquid helium bath at a temperature between 2°K and T/sub c/ are reported in which velocities of thermal propagation were measured for both forward and reverse current directions and new effects were observed. The velocity in the parallel case is significantly higher than in the antiparallel case. (2 figures) (RWR)

00464 (LA-UR—75-751) **Investigation of the sources of asymmetry effects in the velocity of destruction of superconductivity by current in Type II Ta wires.** Overton, W.C. Jr. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-750811—1). Dep. NTIS $4.00.

From 14. international conference on low temperature physics; Leiden, Netherlands (14 Aug 1975).

The phenomenological theories for the velocity of destruction of superconductivity by current can be improved by taking into account the temperature dependences of the thermal conductivities K/sub N/(T), K/sub S/(T) and the specific heats C/sub N/(T), C/sub S/(T). In earlier works these quantities were usually evaluated at temperature T/sub t/, that of the center of the propagating normal(N)—superconducting(S) interface. It was found that the asymmetry in v observed in "dirty" type-II Ta wires could be tentatively explained by K/sub N/(I greater than I/sub i/; parallel case) greater than K/sub N/(I = 0) and K/SSUG N/(I greater than I/sub i/; antiparallel case) less than K/sub N/(I = 0) and propagating interface specific anomaly parameter A(parallel) greater than A(antiparallel) and the width of the propagating interface = 2n' xi(T) with n' = 10, where I/sub i/ is the current at the superconducting—mixed interface. (2 figures) (RWR)

00465 (LA-UR—75-934) **Reflected rarefactions, double regular reflection, and mach waves in aluminum and beryllium.** Neal, T. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 21p. (CONF-750556—1). Dep. NTIS $4.25.

From 5. international conference on high pressure; Moscow, USSR (26 May 1975).

A number of shock techniques which can be used to obtain high-pressure equation-of-state information between the principal Hugoniot and the principal adiabat are illustrated. A rarefaction wave in aluminum shocked to 27.7 GPa [277 kbar] is examined with radiographic techniques and the bulk sound speed is determined. The two stage compression which occurs in a double shock may be attained by colliding two shocks and observing regular reflection. A radiographic method which uses this phenomenon to measure a three-stage compression of aluminum to a density of 4.7 Mg/m³ and beryllium to a density of 3.1 Mg/m³ is presented. The results of a Mach reflection experiment in aluminum are found to disagree substantially with the simple three-shock model. A modified model, consistent with observations, is discussed. In all cases the Gruneisen parameter is determined. (auth)

00466 (LA-UR—75-1258) **Thermodynamic properties of the binary Laves phase compounds of plutonium with the group VIIIa metals.** Campbell, G.M. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 10p. (CONF-750915—5). Dep. NTIS $4.00.

From 5. international conference on plutonium and other actinides; Baden-Baden, F.R. Germany (10 Sep 1975).

The thermodynamic properties of $PuFe_2$, $PuRu_2$ and $PuOs_2$ were determined using fused salt emf cells. The data indicate that there is a regular correlation between the stability of these AB_2 Laves type compounds and their unalloyed atomic radius ratio. The limited amount of data available tends to support the conclusion that other Laves compounds grouped according to their electronic bonding structure show a similar correlation. (auth)

00467 (LA-UR—75-1347) **Anomalous thermal property behaviour of uranium at low temperatures.** Sandenaw, T.A. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 13p. (CONF-750915—3). Dep. NTIS $4.00.

From 5. international conference on plutonium and other actinides; Baden-Baden, F.R. Germany (10 Sep 1975).

Low temperature heat capacity curves are presented for polycrystalline ^{235}U and ^{238}U metals in different microstructural states and of different purities. Thermal conductivity versus temperature curves are shown for low-purity, polycrystalline ^{238}U in the temperature range between approximately 80 and 373°K for metal having undergone varied fabrication procedures. Published information suggests that there will be no structural modification in very pure uranium below room temperature. The influence of impurities on low temperature transitions may be through their effects on dislocation formation. Thermal conductivity and heat capacity runs started at approximately 80°K, after holding specimens at the temperature of boiling liquid nitrogen, do not give results which match up with runs started below 36 to 43°K. Result of measurements started at approximately 80°K indicate that an ordering mechanism is predominating, with microstructure rather than purity being the important factor. This can be explained if ordering at approximately 80°K is through lattice imperfections remaining from prior specimen processing. The drop off in heat capacity appearing above 36°K in the C/sub p/ versus T curves of ^{235}U and ^{238}U suggest the possibility of: (1) heat evolution from a developing antiphase structure or (2) heat evolution similar to that noted with a quenched martensite. Physical property

changes in ^{238}U at 250 to 270°K and at 325 to 350°K seem to be related to the heat evolution which starts at 36°K during adiabatic heat capacity measurements. The data from heat capacity and thermal conductivity measurements are analyzed to help explain the significance of the sometimes very slight physical property changes observed at 36 to 43, approximately 80, 250 to 270 and 325 to 350°K in uranium metal. (auth)

00468 (LA-UR—75-1354) **Entropy correlation for the 4f and 5f metals: relation of electronic properties to metallic radii, magnetic transformations and thermodynamics of vaporization.** Ward, J.W.; Hill, H.H. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 15p. (CONF-750915—4). Dep. NTIS $4.00.

From 5. international conference on plutonium and other actinides; Baden-Baden, F.R. Germany (10 Sep 1975).

Properties of lanthanides and actinides were investigated to establish thermodynamic correlations for elements in these groups. Results of the studies show that the diversity of the actinide series, at least from Ac through Pu, precludes the success of any one theoretical model for the thermodynamic properties of these metals. The entropy has been shown to be a property through which the diverse natures of these elements can be better understood. (auth)

00469 (LBL—3755) **Heat capacity of the superconducting Kondo system (LaCe)Al_2.** Bader, S.D.; Fogle, W.E.; Phillips, N.E.; Maple, M.B.; Luengo, C.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1975. Contract W-7405-ENG-48. 8p. (CONF-750816—1). Dep. NTIS $4.00.

From 4. international conference on chemical thermodynamics; Montpellier, France (26 Aug 1975).

Heat capacity measurements were made on several (LaCe)Al_2 alloys with Ce concentration varying from zero to above the turning point concentration of the re-entrant T/sub c/ vs Ce concentration curve. The measurements extend below the temperature of the maximum in C/sub n/, the normal-state heat capacity, and, for the one sample that shows re-entrant superconducting behavior, below T/sub c2/. Measurements were made on samples with 0, 0.193, 0.640, and 0.906 at. percent Ce substituted for La, in the temperature range 0.07 to 20 K, and in magnetic fields from 0 to 38 kOe. A complete analysis of the data on all samples shows that the lattice and normal state electronic heat capacities of the alloy samples are the same as those of pure $LaAl_2$. (3 figures) (RWR)

00470 (ORO—3262-39) **Factors affecting the determination of activation parameters. Progress report, 1 December 1974—30 November 1975.** Reed-Hill, R.E.; Donoso, J.R. (Florida Univ., Gainesville (USA). Dept. of Materials Science and Engineering). 1975. Contract AT(40-1)-3262. 56p. Dep. NTIS $6.00.

The basic principles involved in thermal activation analysis at low temperatures are reviewed. The definitions of the activation parameters in terms of quantities that can be determined from experiments are reviewed. Without referring to any specific mechanism, the causes for some of the shortcomings of activation analyses are sought in terms of the inherent limitations in accuracy of the measurements and of phenomena that complicate deformation. It appears that the latter, namely dynamic strain aging and mechanical twinning, may account for many failures of thermal activation analyses. (auth)

00471 (SAND—75-5126) **Computational investigation of the effects of barrier layers on the permeation of hydrogen through metals.** Perkins, W.G. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 10p. (CONF-750925—2). Dep. NTIS $4.00.

From Conference on effects of hydrogen on behavior of materials; Jackson, Wyoming, USA (7 Sep 1975).

Results of a computational investigation of the permeation behavior of oxide-coated metal membranes are presented. A steady-state permeation model was developed which promises to be useful in evaluation of oxide layers on metals as hydrogen permeation barriers. The pressure and thickness dependence of steady state permeation through oxide-coated metal membranes is described using plots of logarithmic functions. (JRD)

00472 (UCRL—76537) **Enthalpy and heat capacity of liquid plutonium and uranium.** Thayer, W.L.; Robbins, J.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jul 1975. 9p. (CONF-750915—1). Dep. NTIS $4.00 .

From 5. international conference on plutonium and other actinides; Baden-Baden, F.R. Germany (10 Sep 1975).

The enthalpy and effective heat capacity of delta-plutonium (Pu—1 wt percent Ga-delta alloys) and oralloy (enriched U) at temperatures high in the liquid region were measured. The Super Kukla prompt-burst reactor was used to heat thin wafers of these metals by neutron-induced fission. The temperature increase in the samples was measured with thermocouples and the number of fissions in the sample determined radiochemically. From these data, heat capacity and enthalpy were calculated. For oralloy, a linear relationship was obtained between reactor-core temperature rise and energy deposition for both thermocouple data and radiochemical yields. Also, these two sets of independent data agreed with each other to within +-5 percent for all experiments. The heat capacity of oralloy was calculated as 159 J/kg.°C up to 2200°C. For delta-plutonium, the same linear relationship was observed for thermocouple data. The oralloy data and the plutonium thermocouple data were used to calculate an oralloy-to-plutonium fission ratio of 0.93 and a constant value of 180 J/kg.°C was computed for the effective heat capacity of liquid delta-plutonium up to 2200°C. Because molten plutonium and uranium would chemically attack even the most refractory crucible materials, it would be very difficult to obtain such data by conventional laboratory calorimetry; it appears that the use of neutron heating in these investigations is unique. (auth)

00473 **Critical current density in superconducting niobium films.** Huebener, R.P. (Argonne National Lab., IL); Kampwirth, R.T.; Martin, R.L.; Barbee, T.W. Jr.; Zubeck, R.B. *J. Low Temp. Phys.*; **19**: No. 3-4, 247-258(May 1974).

The critical current was measured in Nb strips of 1 μ m thickness and different widths w prepared by electron-gun vacuum deposition. The substrate temperature during the deposition was varied between room temperature and 800°C. The width of the Nb strips ranged between 20 and 300 μ m. Whereas up to 600°C the different substrate temperatures yielded about the same critical current density J/sub c/ (critical current divided by sample cross section), the specimens prepared with 800°C substrate temperature showed a reduction of J/sub c/ by a factor of 4 to 6. In zero applied magnetic field the samples prepared with 400°C substrate temperature or lower showed a decrease of J/sub c/ roughly proportional to w/sup -1/2/. Such behavior can be understood from a homogeneous and field-independent pinning-force density. The critical current data obtained in an applied perpendicular field, for the high-field regime, were compared with Kramer's theory of flux pinning, which assumes plastic shearing of the flux-line lattice around individual pinning sites during flux flow. (auth)

00474 **Alternative description of hydrogen diffusion in the b.c.c. metals.** Steward, S.A. (Univ. of California, Livermore). *Solid State Commun.*; **17**: No. 1, 75-78(1975).

A so-called triangular interstitial site in body-centered cubic materials provides a shortened diffusion path between tetrahedral sites, and it contributes to the concept of random location of cations in certain systems. The importance of the triangular site to metal—hydrogen systems is emphasized. Dirichlet cells are used to better illustrate the interrelationships of interstitial and atomic locations in cubic lattices. (auth)

00475 **Field-induced-magnetic-moment form factor of metallic chromium.** Stassis, C.; Kline, G.R.; Sinha, S.K. (Ames Lab., IA). *Phys. Rev., B;* **11**: No. 6, 2171-2176(15 Mar 1975).

Polarized-neutron techniques have been used to study the spatial distribution and temperature dependence of the field-induced magnetic moment in metallic chromium. It is demonstrated that the coherent magnetic scattering of neutrons by the induced magnetic moment in chromium may be described in terms of free-ion form factors. The angular distribution of the magnetic scattering is best fitted by having a 60 percent 3d orbital-40 percent 3d spin contribution to the induced moment both above and below the antiferromagnetic transition temperature of the sample. The orbital and spin contribution to the static susceptibility were found to be (98 +- 3) x 10^{-6} emu/mol and (65 +- 2) x 10^{-6} emu/mol, respectively; the gyromagnetic ratio is 1.25 +- 0.04. These results are in good agreement with bulk-susceptibility measurements performed on the same sample, as well as with independent measurements of the gyromagnetic ratio of chromium. The magnitude of the localized induced moment has been found to be temperature independent in the (27 to 200)°C temperature region. This result implies the absence of any well-defined local moment above the antiferromagnetic transition temperature of the sample. (auth)

00476 **Novel superconducting material.** Kawabe, U.; Fukase, S.; Ishibashi, M.; Kudo, M.; Takatoku, K. (to Hitachi, Ltd.). US Patent 3,884,683. 20 May 1975. Priority date 22 Jan 1971, Japan. 8p.

A superconducting material is described which consists essentially of the intermetallic compound (Nb/sub 1-x/Ta/sub x/)/sub k/ Al/sub 1 - y/M/sub y/, where M is Be, B, Si, and C, and x, y, and k are 0 less than or equal to x less than or equal to 0.1, 0.01 less than or equal to y less than or equal to 0.2, and 2.3 less than or equal to k less than or equal to 4.0, respectively. This material has a higher critical temperature than that of the previously known Nb_3Al. (Official Gazette)

00477 Role of vacancy anharmonicity on non-Arrhenius diffusional behavior. Gilder, H.M. (CEN, Fontenay-aux-Roses, France); Lazarus, D. *Phys. Rev., B;* 11: No. 12, 4916-4926(15 Jun 1975).

Curvature in the Arrhenius plot of self-diffusion, usually attributed to the coexistence of two or more separate mobile defects, is shown to be explainable in terms of a single highly relaxed vacancylike defect, in which the anharmonicity of the lattice modes gives rise to a large thermal-expansion coefficient for the defect. A model based on this approach gives excellent agreement for all cases in which curvature has been observed, as well as for others in which no curvature has been detected. (auth)

00478 Electrochemical determination of porosity in nickel electroplates on a uranium alloy. Weirick, L.J. (Sandia Labs., Livermore, CA). *J. Electrochem. Soc.;* 122: No. 7, 937-940(Jul 1975).

This study has shown that for U-Ti alloy specimens galvanically coupled to a nickel sheet in KCl electrolytes, the corrosion potential varies linearly with the logarithm of the exposed area fraction of uranium alloy. It was possible to calibrate the technique so that the exposed base metal area fractions of uranium alloy specimens plated with nickel could be estimated to a reasonable approximation. This technique is relatively nondestructive and offers the advantages of simplicity and high sensitivity, particularly at low porosities. (auth)

00479 Isotope effects on the motion of O—H clusters in Nb. Mattas, R.F. (Argonne National Lab., IL); Birnbaum, H.K. Contract AT(11-1)-1198. *Acta Metall.;* 23: No. 8, 973-977(Aug 1975).

The effect of isotope mass on the behavior of the O—H defect in niobium was studied using internal friction techniques. Large, nonclassical isotope effects were found for the jump frequencies, motion activation enthalpies, and binding enthalpies for the (100) tetragonal O—H and O—D defects. The theories of light element interstitial diffusion are not able to satisfactorily account for the observed effects. (auth)

00480 Superalloys for superservice. *Met. Prog.;* 108: No. 3, 37-46(Aug 1975).

Properties of Fe-, Ni-, and Co-base superalloys are discussed. Their use in reactors, gas well cables, liquid metal pump impellers, aircraft cables, turbines and powder metallurgy parts is reviewed. (JRD)

00481 Alloy selection for exhaust valves. Kocis, J.F. (TRW Inc., Cleveland); Matlock, W.M. *Met. Prog.;* 108: No. 3, 58-60; 62(Aug 1975).

Methods of selecting materials for use in exhaust valves are reviewed. The designs considered are those for use in single alloys for light duty to multiple alloy composites for heavy duty compositions and properties of exhaust valve materials are tabulated and discussed. (JRD)

00482 Electromigration in polycrystalline and single crystal magnesium. Wohlgemuth, J. (Rensselaer Polytechnic Inst., Troy, NY). *J. Phys. Chem. Solids;* 36: No. 10, 1025-1031(Oct 1975).

The electromigration of magnesium single and polycrystal samples was measured under the influence of a d/c current density of approximately 6 x 10^3 A/cm^2 using the vacancy flux technique. The single crystal data were taken on samples with the c-axis of the metal making angles of 22° and 63° respectively with the cylindrical axis of the specimen. Accurate measurements of the longitudinal and transverse motion were made over a period of several weeks and used to calculate a value for the atom drift velocity, V/sub a/. The atom drift velocity is used to calculate Z*, the effective electromigration charge on the ion. All of the observed motion was directed toward the anode. The polycrystal runs yielded an average value of Z*/f = -2.03 +- 0.33. The single crystal runs resulted in an anisotropic drift velocity ratio of V/sub alpha perpendicular to//V/sub alpha parallel/ = 1.4. However, the product of diffusivity times resistivity is anisotropic by the same ratio as the atom drift velocity and the correlation factor f is nearly isotropic for magnesium. As a result Z* is isotropic and turns out to be -1.6. (auth)

00483 Quantum theory of intraband photon-drag effect in solid. Yee, J.H. (Univ. of California, Livermore). *J. Phys. Chem. Solids;* 36: No. 10, 1089-1091(Oct 1975).

It is shown that the Boltzman transport equation for the photon-drag effect induced by the intraband transition can be obtained simply from the density matrix equation for the interacting system consisting of the electrons, photon, and phonon if a proper unitary transformation is made on the density matrix. (auth)

CORROSION AND EROSION

00484 (ARH—1290) Stress corrosion cracking of A515 grade 60 carbon steel. Moore, E.L. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 27 Jul 1971. 12p. Dep. NTIS $4.00.

An investigation was conducted to evaluate the effect of welding method plate thickness, and subsequent stress relief treatment on the stress corrosion cracking propensity of ASTM A515 Grade 60 carbon steel plate exposed to a 5 M $NaNO_3$ solution at 190°F for eight weeks. It was found that all weld coupons receiving no thermal stress relief treatment cracked within eight weeks; all weld coupons given a vibratory stress relief cracked within eight weeks; two of the eight weld coupons stress relieved at 600°F for one hour cracked within eight weeks; none of the weld coupons stress relieved at 1100°F for one hour cracked within eight weeks; and that cracking was generally more severe in coupons fabricated from 7/8 inch plate by shielded metal arc welding than it was in coupons fabricated by other welding methods. (auth)

00485 (ARH-ST—111) Compilation of Hanford corrosion studies. Lini, D.C. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-2130. 36p. Dep. NTIS $3.75.

Experimental Hanford corrosion studies are reviewed with the intent of identifying the types and rates of corrosion encountered, surveying the experimental techniques used to gather corrosion data, and indicating how these data contribute to tank failure predictions. The experimental studies in this document can be divided into the following areas: general and pitting corrosion, stress corrosion cracking, corrosivity of solidified high-level waste, and cathodic protection. (auth)

00486 (ICP—1053) Corrosion of high nickel alloys in combined fluoride solutions for nuclear fuel reprocessing. Paige, B.E.; DePue, N.A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). Jul 1975. Contract E(10-1)-1375. 69p. Dep. NTIS $5.45.

The chemical reprocessing of fuel from the Pressurized Water Reactor (PWR) Core 2, Seed 1 and 2, requires hydrofluoric acid, nitric acid, and sulfuric acid singly and in mixtures. High nickel alloys tested in scoping tests at the boiling point in PWR process solutions included Hastelloy C-276, Hastelloy C-4, Hastelloy S, Hastelloy G, Inconel 625, Inconel 690 and Incoloy 825. Evaluations of weld performance including some metallographic examinations are included. Different methods of welding and different heats of alloys were investigated. The effect of varying compositions and concentration of process solutions were examined in order to select conditions which would minimize corrosion. Corrosion results are also presented for two Hastelloy C276 corrosion test vessels fabricated from 3-inch welded pipe with welded nozzles. These vessels have been exposed to PWR process solution for several months. They have provided valuable information on the performance of welds, the attack at the vapor-liquid interface, and the mode of attack to be expected in process service. (auth)

00487 (ORNL—5025, pp 228-229) Oxygen diffusion in β-zircaloy. Perkins, R.; Bertrand, F.; Saltmarsh, M.J. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The diffusivity of ^{18}O in β-Zircaloy after diffusion anneals at 900 to 1500°C was measured absolutely using proton irradiation and scanning of the ^{18}F. An effective diffusion coefficient of approximately 10^{-8} cm^2/s is estimated. (DLC)

00488 (SAND—75-0103) Low voltage initiation of damaging arcs between electrical contacts. Cuthrell, R.E. (Sandia Labs., Albuquerque, N.Mex. (USA); Sandia Labs., Livermore, Calif. (USA)). Jul 1975. Contract AT(29-1)-789. 27p. Dep. NTIS $4.50.

Metallic arcs were found to precede the firm contacting of electrical contacts which were closed without bounce. When the open-circuit voltages were below the ionization potential, the initiation of these arcs was found to depend on the presence of asperities on the surfaces and on asperity contracting, melting, and pinching off by magnetic forces. The arc is thought to be initiated inductively when the molten metallic asperity contact is pinched off, and the electrode damage is similar to that produced by the arcing of opening contacts. Arcing could not be produced for exceptionally smooth surfaces, or, for rough surfaces when the open-circuit potential was below the melting voltages of the electrode metals. In order to prevent damage to contact surfaces by melting or arcing, it is suggested that test potentials be limited to below the melting voltages, that the current be limited, the test circuits be designed to prevent inductively generated high voltage transients, and the contact surfaces be very smooth. In order to facilitate arc initiation in arc welding applications, it is suggested that the surfaces of electrodes and work pieces be roughened. (auth)

00489 (SAND—75-0191) **Stress corrosion cracking in quenched and underaged U-6 wt.% Nb.** Magnani, N.J. (Sandia Labs., Albuquerque, N.Mex. (USA); Sandia Labs., Livermore, Calif. (USA)). Jul 1975. Contract AT(29-1)-789. 20p. Dep. NTIS $4.00.

Two types of stress corrosion cracking occur in U—6 wt percent Nb. Intergranular (anodic dissolution) cracking occurs in aqueous Cl^- environments. Transgranular (oxide stress rupture) cracking occurs in gaseous environments containing oxygen. Aging the quenched alloy at 200°C for 2 hours increases the yield strength but only slightly lowers the stress corrosion cracking threshold. (auth)

00490 (SAND—75-5159) **Relationship between thermal embrittlement and hydrogen cracking in 18Ni(250) maraging steel.** Rack, H.J. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1974. 12p. (CONF-750925—5). Dep. NTIS $4.00.

From Conference on effects of hydrogen on behavior of materials; Jackson, Wyoming, USA (7 Sep 1975).

The role of grain boundary precipitate structure on the stress corrosion susceptibility of 18Ni(250) maraging steel was examined. Varying solution treatment procedures were used to achieve either a precipitate-free grain boundary or one containing a high density of Ti(C,N) particles. The introduction of these treatments, although drastically affecting the monotonic fracture toughness, did not significantly alter the stress corrosion threshold in 100 percent relative humidity. These results are shown to be consistent with the previous suggestion that, under open circuit conditions, hydrogen-assisted cracking controls the environmental crack growth behavior of 18Ni maraging steels. (auth)

00491 (SAND—75-5710) **Cracking of U—0.75 wt. % Ti in hydrogen and water vapor.** Magnani, N.J. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1974. 16p. (CONF-750925—1). Dep. NTIS $4.00.

From Conference on effects of hydrogen on behavior of materials; Jackson, Wyoming, USA (7 Sep 1975).

The data obtained in this investigation have shown that the crack velocity of U— 0.75 wt percent Ti in H_2 has a linear dependence on time, an exponential dependence on temperature, a power dependence on pressure, and increases as the strength of the material increases. The H_2 cracking data also exhibited an anomalous behavior wherein cracking occurred in the absence of an applied load. This is attributed to corrosion product wedging. UH_3 has a density of 11 g/cm³ while the U--Ti alloy has a density of 18.5 g/cm³. This corresponds to an increase in volume of 70 percent when the hydride is formed. It is felt that the reaction of the fracture surface with the H_2 environment leads tothe formation of copious amounts of hydride which interferes with the relaxation of the crack opening as the stress intensity is lowered. (auth)

00492 Degradation in the biaxial stress-to-failure properties of Type 316 stainless steel exposed to cesium oxides. Rosa, F.; Maiya, P.S. (Argonne National Lab., Ill. (USA)). *J. Nucl. Mater.;* 56: No. 2, 136-144(May 1975).

Tubular specimens of 20 percent cold-worked Type 316 stainless steel were exposed to cesium oxides at 660°C for varying times. Grain-boundary corrosion occurred, and the penetration depths varied from 0 to 250 μm. After the exposure treatment, the specimens were pressurized with helium to investigate the effect of corrosion on the stress-failure properties of the steel at temperatures between 593 and 760°C. The time to failure for the exposed specimens could be predicted from the unexposed-specimen data by assuming that the effect of grain-boundary corrosion is equivalent to the reduction in the thickness of the tube wall. At all temperatures, a decrease in the average diametral strain rate caused the type of failure to change from rupture to pinhole. The pinhole failure was found to be predominantly associated with intergranular fracture mode and the rupture with transgranular fracture mode. (auth)

00493 Method of improving the corrosion resistance of nickel—copper alloys. Tokarz, R.D. (to U.S. Energy Research and Development Administration). US Patent 3,883,379. 13 May 1975. Filed date 21 Dec 1972. 4p.

PAT-APPL-317 456.

The corrosion resistance of nickel-copper alloys containing 63 to 70 wt. percent nickel to water is improved by immersing the alloy in concentrated hydrochloric acid for 24 hours at room temperature prior to exposure of the alloy to water. (auth)

00494 Stress corrosion cracking of alpha brass in a tarnishing ammoniacal environment: fractography and chemical analysis. Pinchback, T.R.; Clough, S.P.; Heldt, L.A. (Michigan Technological Univ., Houghton). *Metall. Trans., A;* 6A: No. 8, 1479-1483(Aug 1975).

Alloy 260 brass specimens under stress were exposed at room temperature to 15N aqueous ammonia solution with 8 g/l of cupric copper predissolved. This environment causes tarnishing of the brass surface and intergranular stress corrosion cracking. Scanning electron microscopy, energy dispersive x-ray analysis, and Auger electron spectroscopy were employed to study fractography, corrosion product composition and distribution within the stress corrosion product composition and distribution within the stress corrosion crack, and fracture surface chemistry characteristic of stress corrosion cracking in this system. A thin oxidized film was detected by Auger spectroscopy at the leading edge of the propagating crack. With continued exposure to the corrosive environment, deposits form on the fracture surface, then coalesce to form a continuous tarnish film that is depleted of zinc. No bulk depletion of zinc was detected in the alloy at the stress corrosion crack leading edge. No evidence of noncrystallographic crack arrest marks was found on the intergranular fracture surface. (auth)

00495 New high-chromium ferritic stainless steel. Pinnow, K.E.; Bressanelli, J.P.; Moskowitz, A. *Met. Eng. Q.;* 15: No. 3, 32-41(Aug 1975).

Crucible 26-1 (²⁶Cr, Ni/sub max//sup 0.5/, 1 Mo) has been developed to provide an outstanding combination of resistance to chloride stress corrosion cracking, resistance to general, pitting, and crevice corrosion, and good fabricability. Available in sheet, strip, tubing, and welding wire, the alloy is finding substantial application in replacing brass and cupronickel, corrosion-resistant high-nickel alloys, and other materials in the food processing, power, chemical, petrochemical, marine, and pulp and paper industries. Its corrosion is compared with other stainless steels, including Type 316. (auth)

00496 Corrosion of condenser tube alloys in sulfide contaminated brine. Bates, J.F.; Popplewell, J.M. (Olin Metals Research Labs., New Haven). *Corrosion;* 31: No. 8, 269-275(Aug 1975).

Increasing sulfide pollution of harbors and river estuaries has markedly increased corrosion of surface condenser alloys using once through cooling water. A laboratory study was conducted of several condenser tube alloys in flowing buffered sodium chloride solution, contaminated periodically with sulfide. The results showed that alternate treatment with sulfide and air was much more aggressive than air alone or sulfide alone. Corrosion performance of the alloys is compared. (auth)

00497 Current density contour maps: experimental determination and analysis. Laliberte, L.H.; Mueller, W.A. (Pulp and Paper Research Inst. of Canada, Quebec). *Corrosion;* 31: No. 8, 286-296(Aug 1975).

The development of a new technique for crevice-free mounting of stainless steel specimens has permitted the investigation of the pitting corrosion of 317L and 2RN65 (sandvik) stainless steels in solutions containing chloride ion. Current Density Contour Maps (CDC Maps) have been constructed from potentiodynamic polarization curves, by plotting iso-current density contours in the potential-pH plane. The results illustrate how the terms (delta log i/delta pH)/sub E/, (delta log i/deltaE)/sub pH/, and (delta pH/deltaE)/sub i/, determined from CDC Maps, can be used to predict susceptibility to pitting and crevice corrosion of specific alloy-electrolyte combinations. Evidence is also presented for two types of pitting sites and/or two pitting mechanisms operating in different potential regions. Pitting at the primary sites was found to depend on the pH and the chloride concentration and to be related to the corrosion history of the surface. Attack at the secondary sites occurred at higher potentials and depended only on the chloride ion concentration. The repassivation potential of the stainless steels tested depended primarily on the bulk chloride concentration, and less on the alloy composition or the pH of the bulk electrolyte. (auth)

00498 Laboratory studies of galvanic corrosion. I. Two-metal couples. Mansfeld, F.; Kenkel, J.V. (Rockwell International, Thousand Oaks, CA). *Corrosion;* 31: No. 8, 298-302(Aug 1975).

Galvanic interaction of stainless steel 304L, Ni 270, Cu, Ti--6Al--4V, Sn, 4130 steel, Cd, and Zn has been studied in 3.5 percent NaCl using galvanic current and weight loss measurements in 24-hour tests. Galvanic couples of 4130 steel and one of the Al alloys 1100, 2024, 2219, 6061, and 7075 have also been evaluated in tap water and distilled water. Galvanic current data can be used to assess both the effect of different dissimilar cathode materials as well as the relative susceptibility to galvanic corrosion of anode materials. For 3.5 percent NaCl, it has been found that the effect of the cathode material decreases in the order Cu greater than Ni greater than stainless steel greater than Ti--6Al--4V, while the relative susceptibility of anode materials decreases in the order Sn greater than Zn greater than 4130 steel greater than Cd. An analysis of data in various electrolytes shows that coupling of 4130 steel

to Al alloys leads to cathodic protection of the steel in 3.5 percent NaCl, but to accelerated corrosion in tap water and distilled water. (auth)

00499 Comparison of isothermal and cyclic oxidation behavior of twenty-five commercial sheet alloys at 1150°C. Barrett, C.A.; Lowell, C.E. (Lewis Research Center, Cleveland). *Oxid. Met.*; 9: No. 4, 307-355(Aug 1975).

Twenty-five commercial nickel-, iron-, and cobalt-base sheet alloys incorporating chromium or chromium and aluminum additions for oxidation resistance were tested at 1150°C in air for 100 h in both isothermal and 1-h cyclic furnace exposures. The alloys were evaluated by sample specific weight change, by type of scale formed, by amount and type of spall, and by sample thickness change and microstructure. In isothermal steady-state oxidation, four types of controlling oxides were observed depending on alloy composition: NiO, Cr_2O_3—chromite spinel, ThO_2-blocked Cr_2O_3, and αAl_2O_3—aluminate spinel. The latter three types are considered protective. In the Cr_2O_3-forming alloys, however, scale vaporization is a critical factor in determining the parabolic scaling rate based on paralinear oxidation. In cyclic oxidation the alloys which form Cr_2O_3—chromite spinel scales were degraded severely when sufficient chromite spinel developed to trigger spalling. The cyclic behavior of the other three types of alloys does not differ greatly from their isothermal behavior. A tentative mass-balance approach to scale buildup, scale vaporization, and scale spalling was used to calculate the critical oxidation parameter—the effective metal thickness change. In general, this change agrees with the measured change to within a factor of 3 if a correction is made for grain boundary oxidation. The calculated thickness change parameter was used to rate the oxidation resistance of the various alloys under isothermal or cyclic conditions. The best alloys in cyclic furnace oxidation tests were either αAl_2O_3—aluminate spinel formers or Cr_2O_3 formers with ThO_2 blockage. (15 fig, 8 tables) (auth)

00500 Oxidation behavior of a Zr—0.5Y alloy. Nasrallah, M.M. (Cairo Univ.); Douglass, D.L. *Oxid. Met.*; 9: No. 4, 357-365(Aug 1975).

A Zr—0.5Y alloy was found to oxidize about 6 times faster than pure zirconium at 400 to 565°C. The activation energies were nearly identical (approximately 32 kcal/mole) and correspond to grain boundary diffusion of oxygen through the scale. The higher oxidation rate of the alloy was attributed to a higher anion vacancy concentration and the assumption that diffusion sites in the lattice and boundaries were in local equilibrium. Measurements on yttria-doped zirconia showed that ionic conductivity was increased markedly by yttrium and extended over a wide range of oxygen pressure. The defect structure of the doped oxide was changed to one of oxygen vacancies, even at the high end of the oxygen pressure range, 10^{-8} to 0.2 atm, over which pure zirconia contains oxygen interstitials. The doped oxide was found to be extrinsic over the entire range of oxygen pressure, and, although ionic conductivity predominated, electronic conductivity was still appreciable. The electronic conductivity, however, was still sufficiently high so that electron transport was not rate-controlling in the predominantly ionic-conducting scale. (auth)

RADIATION EFFECTS

00501 (HEDL-TME—75-32) **Tensile properties of irradiated TZM and tungsten.** Steichen, J.M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1975. Contract AT(45-1)-2170. 34p. Dep. NTIS $4.00.

The effect of neutron irradiation on the elevated temperature tensile properties of TZM and tungsten has been experimentally determined. Specimens were irradiated at a temperature of approximately 720°F to fluences of 0.4 and 0.9 x 10^{22} n/cm² (E greater than 0.1 MeV). Test parameters for both control and irradiated specimens included strain rates from 3 x 10^{-4} to 1 s^{-1} and temperatures from 72 to 1700°F. The results of these tests were correlated with a rate-temperature parameter (T ln A/epsilon) to provide a concise description of material behavior over the range of deformation conditions of this study. The yield strength of the subject materials was significantly increased by decreasing temperature, increasing strain rate, and increasing fluence. Ductility was significantly reduced at any temperature or strain rate by increasing fluence. Cleavage fractures occurred in both unirradiated and irradiated specimens when the yield strength was elevated to the effective cleavage stress by temperature and/or strain rate. Neutron irradiation for the conditions of this study increased the ductile-to-brittle transition temperature of tungsten by approximately 300°F and TZM by approximately 420°F. (auth)

00502 (LBL—3590) **Irradiation induced dislocation climb in Cu—Al alloys of different stacking fault energies.** Kosel, T.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. Contract W-7405-eng-48. 105p. Dep. NTIS $8.25.

Thesis.

Irradiation induced climb of dislocations due to preferential absorption of interstitials was studied by irradiating Cu—Al alloys of different stacking fault energies. Nucleation of rhombus shaped perfect dislocation loops was observed, and their growth was studied. The sides of the loops lay accurately on the two (111) planes which contain the Burgers vector and were often bowed out slightly on these glide planes. Rotation of the loops on the glide cylinder away from the pure edge orientation was observed, as well as loss of loops by slip along the glide cylinder to the foil surface. These observations suggest that the jog density on the loop sides is low. It is shown that at a given temperature there exists a minimum damage rate for growth, and that this is strongly dependent on stacking fault energy. This is discussed in terms of a model in which the rate controlling process in the climb of these loops is assumed to be the nucleation of jogs. (auth)

00503 (ORNL—5025, pp 228) **High-energy neutron sputtering yields for niobium and gold.** Jenkins, L.H.; Noggle, T.S.; Saltmarsh, M.J.; Smith, G.; Reed, R.;. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Niobium and gold samples were subjected to neutron irradiation in order to investigate sputtering yields for neutron fluences up to 4 x 10^{16} neutrons/cm². Upper limits were placed on sputtering yields but analysis is incomplete. (1 figure) (SDF)

00504 (ORNL—5025, pp 225-228) **Heavy-ion-induced radiation damage.** Bloom, E.E.; Farrell, K.; Kenik, A.E.; Packan, N.H.; Saltmarsh, M.J. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

4-MeV nickel ions are being used to bombard materials to induce swelling and other radiation effects. The investigation method and objectives are discussed. (3 figs) (GHT)

00505 (ORNL—5025, pp 229-230) **Helium injection for partial simulation of controlled thermonuclear research radiation effects.** Wiffen, F.W.; Woods, J.W. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The injection technique is to degrade an approximately 50-MeV ORIC alpha beam with a rotating energy degrader of continually variable thickness before it reaches the target, which is scanned to produce a nearly uniform He content. A He injection run was made on metal and alloy specimens. (DLC)

00506 Effect of neutron irradiations on superconducting properties of A-15 compounds undoped and doped with ^{10}B and ^{235}U. Bauer, H. (Univ. of Giessen, Ger); Saur, E.J.; Scheitzer, D.G. *J. Low Temp. Phys.*; 19: No. 3-4, 171-187(May 1974).

The effect of lattice damage caused by room temperature irradiations with products of $^{10}B(n,\alpha)^7Li$ reactions and ^{235}U fissions and with fast neutrons on transition curves, quenching curves, and lattice constants of Nb_3Sn, Nb_3Al, $Nb_3(Al,Ge)$, and V_3Si have been investigated. The critical currents in transverse magnetic fields could be increased up to more than one order of magnitude. For heavily irradiated samples drastically reduced values for the critical currents, the upper critical fields, and the transition temperatures were observed. The lattice constants were increased up to 0.5 percent by irradiation. (auth)

00507 X-ray studies of defect clusters in copper. Larson, B.C. (Oak Ridge National Lab., TN). *J. Appl. Crystallogr.*; 8: 150-160(Apr 1975).

X-ray diffraction techniques provide powerful tools for the study of lattice defects in crystals. For the case of clustered defects, many of these techniques are based on the scattering properties of the strained regions surrounding the defects rather than on the scattering from the defects themselves. This is particularly true of Huang diffuse scattering, anomalous transmission, and lattice-parameter measurements; the interpretation of these measurements, therefore, relies on a detailed knowledge of the strains around the defects. The Fourier-transformed, long-range strain fields entering into the Huang diffuse scattering can be expressed in terms of the dipole force model, and in this work comparisons of calculations based on this model with measured scattering from spherical precipitates and dislocation loops in copper are reviewed. The use of integral diffuse scattering measurements, made with a two-axis diffractometer, are discussed in terms of a direct analysis of the defect systems in the form of defect concentrations and size distributions and this procedure is applied to the study of the effects of irradiation conditions and post-irradiation annealing on the defect distributions in neutron-irradiated copper. The relation of these diffuse scattering measurements to lattice parameter, anoma-

lous transmission, electron microscopy, and electrical resistivity measurement is also discussed. (auth)

00508 Radiation-induced defect buildup and radiation-enhanced diffusion in a foil under energetic bombardment. Lam, N.Q. (Argonne National Lab., Ill. (USA)). *J. Nucl. Mater.*; **56**: No. 2, 125-135(May 1975).

The distribution of interstitials, monovacancies, and vacancy aggregates containing two to six vacancies in a silver foil under irradiation was calculated as a function of both distance from the surface of the foil and irradiation time by numerically solving the rate equations for various temperatures (0 to 250°C) and internal sink concentrations (0.10^{-5} and 10^{-3}). The mobile defects (interstitials, monovacancies, divacancies and trivacancies) were assumed to react with each other, to annihilate at fixed sinks and to diffuse to the surface. Vacancy clusters larger than trivacancies were considered to be immobile, able to grow, but not dissociate. Humps on the steady-state concentration profiles for monovacancies and immobile vacancy clusters were found near the surface of a foil, provided the irradiation temperature and sink density were low and/or the defect production rate was quite high. The radiation-enhanced diffusion coefficient, D/sub rad/, of the material was calculated from the diffusivities of mobile defects and their steady-state concentrations, as a function of temperature, sink concentration, and Frenkel-pair production rate. (auth)

00509 Effect of fast reactor fluence on postirradiation rupture of Type 316 stainless steel. Lovell, A.J. (Westinghouse Hanford Co., Richland, WA). *Nucl. Technol.*; **26**: No. 3, 297-306(Jul 1975).

Specimens of annealed Type 316 stainless steel were irradiated in Experimental Breeder Reactor II at temperatures ranging from 900 to 1450°F and to fluences from 0.2 to 7 x 10^{22} N/cm² (E/sub n/ greater than 0.1 MeV). Uniaxial and biaxial creep tests were performed at 1000, 1100, 1200, and 1400°F with rupture times from less than 1 to greater than 1000 h. The test data show that rupture life changes due to irradiation can be substantial. The stress, fluence, and temperature dependence of rupture life are reduced to a mathematical form, t/sub r/ equals A(t/sub i//t/sub n/)sigma/sup/B/, where A and B are temperature-dependent terms and the term t/sub i/t/sub n/ is temperature and fluence dependent. (auth)

00510 Irradiation effects on mechanical properties of an SMAW deposited Type 308 stainless steel. Ward, A.L. (Westinghouse Hanford Co., Richland, WA). *Weld. J. (N.Y.)*; **54**: No. 8, 259s-264s(Aug 1975).

Pre- and post-irradiation tensile and creep-rupture tests have been conducted on a shielded metal-arc welding (SMAW)-deposited Type 308 stainless steel containing controlled residual elements (CRE) boron, phosphorus and titanium. Fast reactor (EBR-II) neutron irradiation produced changes in the mechanical properties which are broadly consistent with trends established in wrought austenitic stainless steels. However, some behavioral differences, both prior to and after irradiation, are noted: higher as-deposited yield strength, lower ductility, lower ability to strain harden and a lower irradiation damage accumulation rate in the CRE 308 weld metal. All of these differences can be associated with inherent differences in the microstructure and thermal-mechanical history between the weld deposited CRE 308 and the wrought Type 304 stainless steel. (auth)

CERAMICS, CERMETS, AND REFRACTORIES

00511 (COO—2390-7) **Basic research in crystalline and noncrystalline ceramic systems. Annual report, March 1, 1974—February 28, 1975.** (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 1975. Contract E(11-1)-2390. 73p. Dep. NTIS $6.75.

Research results reported are: heats of transport in hypo- and hyperstoichiometric UO_2 in thermal gradients; fabrication of transparent PLZT; creep in Al_2O_3; ambipolar diffusion and diffusional creep; diffusion-controlled final-stage sintering; sintering mechanism in Al_2O_3; internal stresses in polycrystalline Al_2O_3; x-ray study of the high-temperature alpha form of AgI single crystal; theory of effects of transmutation on radiotracer diffusion in ionic solids; ^{204}Tl diffusion in KCl at 240 to 700°C; diffusion of Ni^{2+} in MgO; defect (diffusion) equilibration kinetics in CoO; diffusional contributions to grain boundary-related damping; color boundary migration in doped Al_2O_3; defect studies in MgO and other solids; preparation of Al_2O_3-doped MgO; space charges and dielectric losses in MgO; production of thin MgO foils; precipitation in MgO; grain boundary segregation in Li-doped NiO; various research needs in ceramic science; and a test of a prototype ZrO_2—UO_2 fuel cell. (DLC)

00512 (RDT-M—6-6T(8-75)) **High-strength, high-temperature bolting materials. (ASME SA-453 with additional requirements).** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Reactor Research and Development). Aug 1975. RSO .

This standard covers bolting material (bars, bolts, screws, studs, stud bolts) for nuclear and associated applications. The additional requirements and optional provisions include testing, examination by ultrasonic and other means, Charpy V-notch, grain size, etc. (DLC)

PREPARATION AND FABRICATION

00513 (ARH-SA—213) **Production of ceramic grade plutonium dioxide.** Peabody, C.M.; Doto, P.C. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Apr 1975. Contract AT(45-1)-2130. 17p. (CONF-750607—25). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Ceramic grade plutonium dioxide is produced at Hanford using the plutonium(IV) oxalate process. Standards established by the Energy Research and Development Administration define acceptable product characteristics. The production of oxide meeting these standards requires proper feed preparation and control of process parameters regarding the precipitation, filtration, and calcination steps as well as stringent product handling requirements. (auth)

00514 (COO—2390-8) **Firing: the proof test for ceramic processing.** Kingery, W.D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Materials Science and Engineering). 1975. Contract AT(11-1)-2390. 22p. (CONF-750131—1). Dep. NTIS $4.25.

From 10. university conference on ceramic science; Gainesville, Florida, USA (27 Jan 1975).

The object of ceramic processing is to form ware having certain shapes and properties. Thus, one test of the success of processing procedures must be in terms of the resulting structure and characteristics of a material after firing. During the firing process some few variations resulting from processing may be evened out, but the great majority of variation tends to be amplified. Examination of a few cases illustrates the nature of the defect amplification process. (auth)

00515 (GA-A—13432) **Preparation of silicon—aluminum nitrogen compounds by reactive ion plating.** Chin, J.; Elsner, N.B. (General Atomic Co., San Diego, Calif. (USA)). 23 Apr 1975. 18p. (CONF-750922—1). Dep. NTIS $4.00.

From 5. international conference on chemical vapor deposition; Bucks, UK (22 Sep 1975).

(Si,Al)N alloys were deposited by reactive ion plating from Si and Al evaporation and NH_3 or NH_3 + 1 per cent SiH_4 gas mixtures. Control of stoichiometry in these deposits was difficult to achieve. Reducing the rate of evaporation of Si during Si_3N_4 deposition was the most effective means of controlling the Si content of this deposit. The presence of O, an unavoidable contaminant in these deposits, was most likely the result of adsorbed moisture from large-surface-area cold walls and heat shields within the coating chamber. (Si, Al)N deposits were amorphous and had large columnar grains composed of smaller 0.2- to 0.6-μm grains. There were no observable changes in the morphology of the deposits with substrate temperatures of 100 to 300°C during deposition. Adhesion of (Si, Al)N deposits to a variety of surfaces, i.e., SiMo, glass, Al_2O_3, and pyrocarbon, was good. Rates of deposition were 350 to 7600 A/min depending on the deposition procedures used. (auth)

00516 (SLA—73-0957) **Technique for sealing Corning Code 1720 glass to molybdenum.** Eagan, R.J. (Sandia Labs., Albuquerque, N.Mex. (USA); Sandia Labs., Livermore, Calif. (USA)). Nov 1973. Contract AT(29-1)-789. 24p. Dep. NTIS $4.25.

A technique of sealing Corning Code 1720 glass to molybdenum in an inert atmosphere was developed, which eliminates the formation of volatile MoO_3 during seal fabrication. The method consists of pressing the molten glass into the desired shape using graphite molds and the metal piece to be sealed. To obtain stronger seals with Code 1720 glass, minor constituents were added to the glass to obtain non-volatile oxides of the molybdenum during seal formation. (auth)

00517 Sintering uranium oxide in the reaction product of hydrogen-carbon dioxide mixtures. De Hollander, W.R.; Nivas, Y. (to General Electric Co.). US Patent 3,872,022. 18 Mar 1975. Filed date 9 May 1973. 10p.

Compacted pellets of uranium oxide alone or containing one or more additives such as plutonium dioxide, gadolinium

oxide, titanium dioxide, silica, and alumina are heated to 900 to 1599°C in the presence of a mixture of hydrogen and carbon dioxide, either alone or with an inert carrier gas and held at the desired temperature in this atmosphere to sinter the pellets. The sintered pellets are then cooled in an atmosphere having an oxygen partial pressure of 10^{-4} to 10^{-18} atm of oxygen such as dry hydrogen, wet hydrogen, dry carbon monoxide, wet carbon monoxide, inert gases such as nitrogen, argon, helium, and neon and mixtures of ayny of the foregoing including a mixture of hydrogen and carbon dioxide. The ratio of hydrogen to carbon dioxide in the gas mixture fed to the furnace is controlled to give a ratio of oxygen to uranium atoms in the sintered particles within the range of 1.98:1 to about 2.10:1. The water vapor present in the reaction products in the furnace atmosphere acts as a hydrolysis agent to aid removal of fluoride should such impurity be present in the uranium oxide. (Official Gazette)

00518 Method for producing highly pure sintered polycrystalline yttrium oxide body having high transparency. Toda, G.; Matsuyama, I.; Tsukuda, Y. (to Hitachi, Ltd.). US Patent 3,873,657. 25 Mar 1975. Priority date 25 Aug 1972, Japan. 14p.

When highly pure yttrium oxide is press molded into a desired shape and then the press molded body is sintered at an elevated temperature in the presence of a beryllium compound, a sintered polycrystalline yttrium oxide body excellent in transparency is easily obtained at a comparatively low molding pressure and at a comparatively low sintering temperature. (Official Gazette)

00519 Method for producing polycrystalline boron nitride. Alexeevskii, V.P.; Bochko, A.V.; Dzhamarov, S.S.; Karpinos, D.M.; Karyuk, G.G.; Kolomiets, I.P.; Kurdyumov, A.V.; Pivovarov, M.S.; Frantsevich, I.N.; Yarosh, V.V. US Patent 3,876,751. 8 Apr 1975. Priority date 18 Dec 1972, Ukrainian SSR. 6p.

A mixture containing less than 50 percent of graphite-like boron nitride treated by a shock wave and highly defective wurtzite-like boron nitride obtained by a shock-wave method is compressed and heated at pressure and temperature values corresponding to the region of the phase diagram for boron nitride defined by the graphite-like compact modifications of boron nitride equilibrium line and the cubic wurtzite-like boron nitride equilibrium line. The resulting crystals of boron nitride exhibit a structure of wurtzite-like boron nitride or of both wurtzite-like and cubic boron nitride. The resulting material exhibits higher plasticity as compared with polycrystalline cubic boron nitride. Tools made of this compact polycrystalline material have a longer service life under impact loads in machining hardened steel and chilled iron. (Official Gazette)

00520 Method for production of transparent yttrium oxide. Dutta, S.K.; Gazza, G.A. (to Secretary of the Army). US Patent 3,878,280. 15 Apr 1975. Filed date 5 May 1970. 4p.

The method comprises vacuum hot pressing the yttrium oxide (Y_2O_3) powder in a graphite die at temperatures of between 1300 to 1500°C and uniaxial pressures of between 5000 to 7000 psi, for a period of 1 to 2 hours. (Official Gazette)

00521 Low temperature metallization of ferrite. Bondley, R.J. (to U.S. Energy Research and Development Administration). US Patent 3,881,038. 29 Apr 1975. Filed date 7 May 1974. 9p.

PAT-APPL-467,682.

A method is provided for metallizing a ferrite at low temperatures. The method includes depositing a layer of lead on the ferrite, coating the lead layer with titanium hydride, distributing lead solder upon the titanium hydride, heating the ferrite until the lead solder flows uniformly over the lead layer, and slowly cooling the ferrite. (auth)

00522 Process for controlling end-point density of sintered uranium dioxide nuclear fuel bodies and product. Lay, K.W. (to General Electric Co.). US Patent 3,883,623. 13 May 1975. Filed date 17 Oct 1972. 10p.

A process is described for controlling the end-point density of a sintered uranium dioxide nuclear fuel body and the resulting product. Uranium dioxide powder having a size ranging up to 10 microns is mixed with a precursor to uranium dioxide, such as ammonium diuranate, having an average agglomerated particle size ranging from about 20 microns to 1 millimeter and the mixture is formed into a pressed compact or green body. The precursor to uranium dioxide has a density lower than that of the uranium dioxide powder and is used in an amount which results in discrete low density regions in the green body which range from about 5 percent to 25 percent by volume of the green body. The green body is sintered to decompose the precursor and produce a sintered body having discrete low density porous regions which reduce the end-point density of the sintered body by at least 2 percent. The sintered body has an end-point density ranging from 85 percent to 95 percent of the theoretical. (Official Gazette)

00523 Preparation of beryllium hydride. Bergeron, C.R.; Baker, R.W. (to Ethyl Corp.). US Patent 3,883,645. 13 May 1975. Filed date 8 Dec 1967. 8p.

Beryllium hydride of high bulk density, suitable for use as a component of high-energy fuels, is prepared by the pyrolysis, in solution in an inert solvent, of a ditertiary-alkyl beryllium. An agitator introduces mechanical energy into the reaction system, during the pyrolysis, at the rate of 0.002 to 0.30 horsepower per gallon of reaction mixture. (Official Gazette)

00524 Preparation of beryllium hydride. Roberts, C.B. (to Dow Chemical Co.). US Patent 3,883,646. 13 May 1975. Filed date 28 Dec 1967. 4p.

A process is described for preparing beryllium hydride by the direct reaction of beryllium borohydride and aluminum hydride trimethylamine adduct. Volatile by-products and unreacted reactants are readily removed from the product mass by sublimation and/or evaporation. (Official Gazette)

00525 Preparation of beryllium hydride. Lowrance, B.R. (to Ethyl Corp.). US Patent 3,885,025. 20 May 1975. Filed date 26 Feb 1962. 4p.

A process is described for the preparation of beryllium hydride which comprises pyrolyzing, while in solution in a solvent inert under the reaction conditions, with respect to reactants and products and at a temperature in the range of about 100° to about 200°C, sufficient to result in the formation of beryllium hydride, a di-t-alkyl beryllium etherate wherein each tertiary alkyl radical contains from 4 to 20 carbon atoms. The pyrolysis is carried out under an atmosphere inert under the reaction conditions, with respect to reactants and products. (Official Gazette)

00526 Method of producing gel spheres and gelation apparatus. Simpson, M.P.; Stockwell, C.L. (to United Kingdom Atomic Energy Authority). US Patent 3,886,086. 27 May 1975. Priority date 24 Jun 1971, United Kingdom of Great Britain and Northern Ireland. 4p.

In certain gelation processes the gelling of liquid droplets to produce gel spheres is achieved by allowing the droplets to fall into a liquid reagent which acts to gel the droplets. According to the present invention, a foam layer is provided above the surface of the liquid reagent to prevent the droplets from contacting the surface of the liquid reagent at a velocity sufficient to disrupt or substantially distort the droplets. Gelation apparatus for conducting the process is also disclosed, said apparatus having a column vertically divided by a baffle into a turbulent bubble region, and a substantially quiescent region through which the droplets fall after the partially gelled droplets have previously passed through the foam layer. (Official Gazette)

00527 UH_3 cermet. Kasberg, A.H. (to Atlantic Richfield Co.). US Patent 3,888,795. 10 Jun 1975. Filed date 3 Oct 1973. 4p.

UH_3—ductile metal cermet is used as a radiation shield in a shipping cask for spent nuclear fuel rods. The ductile metal may be Cu, Al, Pb, or Cu—Pb. (DLC)

00528 Aluminum titanate crucible for molten uranium. Asbury, J.J. (to U.S. Energy Research and Development Administration). US Patent 3,890,140. 17 Jun 1975. Filed date 10 May 1973. 6p.

PAT-APPL-359,052.

An improved crucible for molten uranium is described. The crucible or crucible liner is formed of aluminum titanate which essentially eliminates contamination of uranium and uranium alloys during molten states thereof. (auth)

00529 Method of producing thermally stable uranium carbonitrides. Ugajin, M.; Takahashi, I. (to Japan Atomic Energy Research Inst.). US Patent 3,892,838. 1 Jul 1975. Priority date 16 Oct 1971, Japan. 6p.

A thermally stable uranium carbonitride can be produced by adding tungsten and/or molybdenum in the amount of 0.2 wt percent or more, preferably 0.5 wt percent or more, to a pure uranium carbonitride. (Official Gazette)

00530 α-MoC superconductor fibers. Economy, J.; Smith, W.D. (to Corborundum Co.). US Patent 3,897,542. 29 Jul 1975. Filed date 17 Dec 1973. 8p.

Alpha-MoC, having a face-centered-cubic crystal structure, can be prepared in fiber form by subjecting a fiber having a surface comprising dimolybdenum monocarbide to an electric voltage sufficient to raise momentarily the temperature of the fiber surface to a temperature at which the α-MoC is the most stable thermodynamically. The fiber so produced can have a carbon core, or the fiber can be entirely converted to α-MoC. This fiber is useful, for example, as a superconductor material for such applications as

windings on magnets. The precursor fiber having a surface comprising dimolybdenum monocarbide can be produced by reacting a carbonfiber with hydrogen and molybdenum pentachloride in a reaction furnace. (Official Gazette)

00531 Preparation, structure, and properties of europium ruthenium hydride. Thompson, J.S.; Moyer, R.O. Jr.; Lindsay, R. (Trinity Coll., Hartford). *Inorg. Chem.*; 14: No. 8, 1866-1869(Aug 1975).

Eu_2RuH_6 is formed by allowing EuH_2 and Ru to react at 800° in approximately 1 atm of hydrogen. The ternary hydride is a dark red, air-stable crystalline solid which appears to be thermally stable to 900°. An analysis of x-ray powder diffraction data and density measurements suggests that the structure is consistent with the Fm3m space group wherein the ruthenium atoms assume four-fold occupancy and europium atoms assume eightfold occupancy in a fluorite type lattice. Magnetic susceptibility measurements between 77 and 296°K show that Eu_2RuH_6 obeys a Weiss—Curie law with THETA = +43°K indicative of ferromagnetic interactions. The measured effective magnetic moment for the europium ion in Eu_2RuH_6 is 7.82 BM assuming no contributions from the ruthenium and hydrogen. This suggests the europium ions are divalent based on a comparison with a calculated value of 7.94 BM for S = /sup 7/2/ . Electrical resistivity measurements indicate that Eu_2RuH_6 behaves as a semiconductor. (auth)

STRUCTURE AND PHASE STUDIES

00532 (LBL—3775) **Characterization of RF sputtered ZnO piezoelectric films using transmission electron microscope.** Yeh, K.W.; Muller, R.S.; Wu, W.K.; Washburn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1975. Contract W-7405-ENG-48. 3p. (CONF-750825—3). Dep. NTIS $4.00.

From 33. annual meeting of the Electron Microscopy Society of America; Las Vegas, Nevada, USA (11 Aug 1975).

The texture perfection structure of two rf sputtered ZnO films was studied as a function of substrate temperature. The perfection and grain size were found to be influenced by the substrate temperature (75 and 250°C), with the better texture and larger grain size occurring at 250°C. (DLC)

00533 (SAND—75-5081) **Thermodynamics of the uranium (α, β and γ phases)-hydrogen system.** Northrup, C.J.M. Jr. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 8p. (CONF-750915—6). Dep. NTIS $4.00.

From 5. international conference on plutonium and other actinides; Baden-Baden, F.R. Germany (10 Sep 1975).

Pressure-composition isotherms have been obtained for the uranium-hydrogen system over the pressure range from 0.1 to 680 atmospheres at temperatures ranging from 450 to 846°C. The hydride (delta) was formed from high purity uranium and pressure—temperature plots were obtained for the (U/sub alpha/, delta), (U/sub beta/, delta), (U/sub gamma/, delta) two phase regions. Results of the investigation indicate that in contrast to the work of Chevallier, Spitz, and Blum [Chevallier et al., Acad. Sci., 264: 96(1967)], the uranium-hydrogen system retains broad, flat, two phase plateaus on the pressure-composition isotherms to temperatures as high as 846°C. The effect of oxygen impurities is noted and it was found that the enthalpy of formation of the hydride from pure uranium was -28.9 kcal mol^{-1}. The three dimensional phase diagram for the system is discussed and the gas-liquid, gas-solid interface is given delineating the known phase boundaries. (auth)

00534 (UCRL—51857) **An experimental study of LiH stoichiometry at elevated temperatures and pressures.** Piwinskii, A.J.; Lilley, E.M.; Smith, G.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jun 1975. Contract W-7405-Eng-48. 16p. Dep. NTIS $4.00.

The stoichiometry of LiH was studied at 500 to 900°K at hydrogen pressures between 2.5 and 6.0 GPa. Results and interpretation are complicated by the presence of ubiquitous intermetallic compounds from encapsulating materials, which are formed at pressures below 4.0 GPa. The most definitive results were produced in an assembly that consisted of a Ag—Pd inner capsule and tantalum outer capsule at a pressure of 5.0 GPa and 733°K. This run produced no change in LiH stoichiometry, nor any change in the NaCl-type crystal structure. It is concluded that up to a pressure of 6.0 GPa and a temperature of 803°K, no quenchable LiH/sub n/ with n greater than 1 can be produced. (auth)

00535 (UCRL—51865) **Isotherms for the U-UH_3-H_2 system at temperatures of 700°-1050°C and pressures to 137.9 MPa.** Lakner, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jul 1975. Contract W-7405-Eng-48. 28p. Dep. NTIS $4.00.

A new pressure system utilizing a heated internal pressure vessel was used to obtain pressure vs composition isotherms for the U—H system over the range 700 to 1050°C at pressures up to 137.9 MPa (1361 atm). The experimentally determined "plateau" pressures are compared with values extrapolated from lower temperatures and pressures previously obtained by other workers. The current investigation shows that, in contrast to the work of Chevalier, et al., the U—H system retains broad two-phase plateaus at temperatures as high as 1050°C. (19 fig) (auth)

00536 Yttria—Hafnia system. Stacy, D.W.; Wilder, D.R. (Iowa State Univ., Ames). *J. Am. Ceram. Soc.*; 58: No. 7-8, 285-288(1975).

Phase equilibria in the yttria-hafnia system were investigated by high-temperature and room-temperature x-ray diffraction. The HfO_2 transformation, solid solution limits, and liquidus temperatures are given. A tentative phase diagram is proposed. (auth)

00537 Unified model of the insulator—metal transition in Ti_2O_3 and the high-temperature transitions in V_2O_3. Zeiger, H.J. (Massachusetts Inst. of Tech., Lexington). *Phys. Rev., B;* 11: No. 12, 5132-5144(15 Jun 1975).

A unified band-crossing model of the insulator—metal transition in Ti_2O_3 and the high-temperature transition in V_2O_3 is presented. The model is based on a Hartree-Fock free-energy calculation including electron-electron Coulomb energy, elastic energy, and band-electron entropy, and taking into account the partial overlap of e(π) bonding and antibonding bands. Below the transition temperature, the a_1 bonding band is taken to lie below the e(π) bonding band in Ti_2O_3, and above the Fermi level in the e(π) bonding band in V_2O_3. This difference in ordering in the model calculation is determined largely by the difference in electron-electron Coulomb energy for Ti_2O_3 and V_2O_3. The transitions in Ti_2O_3 and V_2O_3 are ascribed to the crossing of the a_1 bonding band and the e(π) bonding band as a function of temperature, due mainly to competition between electron-electron energy and band-electron entropy. The model calculation is applied to a description of the behavior of lattice parameters, specific heat, and magnetic susceptibility through the transition temperature in Ti_2O_3 and V_2O_3. The effect of the substitution of impurities on the nature of the transitions is discussed. The calculated properties of Ti_2O_3 are found to be at best only in qualitative agreement with experiment, and in the case of the magnetic susceptibility, in serious disagreement. It is suggested that the disagreement may be in part due to the formation of singlet excitons in Ti_2O_3. On the other hand, the model predictions are nearly quantitatively correct for many of the properties of V_2O_3. The Knight shift and nuclear-spin relaxation rate of ^{51}V and V_2O_3 are treated, and are found to agree well with experiment. (auth)

00538 Crystal structures of the fluorite-related intermediate rare-earth oxides. Kunzmann, P.; Eyring, L. (Arizona State Univ., Tempe). *J. Solid State Chem.*; 14: No. 3, 229-237(Jul 1975).

The binary oxides of the rare-earth elements are, except for the A- and B-type sesquioxides, members of a fluorite-related homologous series R/sub n/O/sub 2n-2/ (n = 4, 6, 7, 9, 10, 11, 12, and infinity are well established and a related phase with n =$10^1/_2$ has been reported). In this paper an electron optical study of members of the series is discussed which reveals the unit cell dimensions and possible space groups of the intermediate phases as well as the transformation matrices in terms of the fluorite substructure. This information reveals the structural relationships among the members of the series as well as the highest common structural feature involved. Structures are proposed for members of this series consistent with the new results obtained and with the data already in existence. (auth)

00539 Note on the crystal structure of V_2O_3. Asbrink, S. (Univ. of Stockholm). *Mater. Res. Bull.*; 10: No. 8, 861-863(Aug 1975).

The observation of a great many very weak extra reflections in the x-ray diffraction spectrum of a single-crystal of V_2O_3 indicates slight deviations from the centric atomic arrangement. The indicated space groups are P2/c and Pc with a unit cell orientation different from the one originally used. A recently reported phase transition near 150°C has been confirmed by DTA measurements. (auth)

00540 Electron microscopy study of anodic WO_3. Papadopoulos, D.; Manolikas, C.; Spyridelis, J. (Univ. of Thessaloniki, Greece). *Mater. Res. Bull.*; 10: No. 8, 847-852(Aug 1975).

Amorphous anodic tungsten trioxide films were studied by electron microscopy. Observations support that during electron-beam heating, various forms of nonstoichiometric tungsten oxide occur which subsequently accommodate with shear structure formation. (auth)

00541 Phase diagram of Al—Ga—In—As quaternary system. Nakajima, K.; Osamura, K.; Murakami, Y. (Kyoto Univ.). *J. Electrochem. Soc.*; 122: No. 9, 1245-1248(Sep 1975).

The phase diagram of the Al—Ga—In—As quaternary system has been determined experimentally for several Al isoconcentration sections. The liquidus data were obtained by DTA, and the solidus data were determined from liquid epitaxial layers grown on GaAs substrates by using EPMA. The phase diagram was calculated by using a simple solution model. Most of the nine interaction parameters necessary for the present calculation are the same as those used in the corresponding binary and ternary phase diagrams, and the remaining three parameters, Ω/sub GaAs/ /sup l/, Ω/sub AlAs-InAs//sup s/, and Ω/sub GaAs-InAs//sup s/, were determined by fitting each calculated phase diagram to the experimental data. (auth)

MECHANICAL PROPERTIES

00542 (SAND—75-0346) **Mechanical properties of molybdenum-sealing glass-ceramics.** Swearengen, J.C.; Eagan, R.J. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jul 1975. Contract AT(29-1)-789. 36p. Dep. NTIS $5.00.

Elastic constants, thermal expansion, strength, and fracture toughness were determined for a molybdenum-sealing glass-ceramic containing approximately 31 volume percent Zn_2SiO_4 crystals in a glass matrix. The microstructure was studied for two different crystallization treatments and moderate changes in composition. Mechanical properties of the composite were compared with the properties of the constituent phases through application of mixture theory and by fractographic observations. The reinforcing effects of the crystal phase at room temperature are evident in comparison with the properties of the residual glass but not necessarily in comparison with the parent glass. Fracture toughness of the composite depends primarily upon additive properties of the separate phases instead of by interactive effects such as microcracks. (auth)

00543 (SAND—75-0347) **Parametric study of the diametral compression test for ceramics.** Marion, R.H.; Johnstone, J.K. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jul 1975. Contract AT(29-1)-789. 78p. Dep. NTIS $7.00.

The effects of sample size and padding material on the results obtained from the diametral compression test are reported. A series of uniform alumina samples ranging from 6.35 mm diameter and 3.175 mm long to 12.70 mm diameter and 12.70 mm long were tested. The padding materials tested included none, Cu, Al, Pb, IBM cards and polystyrene. The results show that the ultimate tensile strength of the samples is dependent on sample size and the padding material used. Tests were also conducted on simulated nuclear waste forms. The first direct observation of the initiation of secondary cracks in the triple-cleft fracture mode is reported. (auth)

00544 (UCRL-Trans—10910) **High frequency damping mechanisms in disperse systems.** Just, W.; Dworak, U.; Leiber, C.O. Translated from *Planseeber. Pulvermet.*; 20: No. 3, 219-232(Sep 1972). 17p. Dep. NTIS $4.00.

Gust and Royce had determined the hugoniotelastic limits of different grades of alumina and high alumina resp. Samples of this charge had been investigated by metallographic means. Taking into account an earlier mentioned acoustical model, described in this paper, values of viscosity and loss angle of Young modulus are calculated from the shock-impedance, the hugoniotelastic limit, and the maximum size of pores. The loss is in the frequency range of about 50—100 Mc dominant and determines fracture. (auth)

00545 (UCRL-Trans—10909) **Influence of impurities and blending agents on the dynamic behavior of the aluminum oxide matrix.** Leiber, C.O. Translated from *Ber. Dtsch. Keram. Ges.*; 50: No. 1, 34-35(1973). 6p. Dep. NTIS $4.00.

According to a recently developed solid-state acoustical model, the influence of various possible compounds of alumina-ceramics on its dynamical behavior is ranged in the order of severity. (auth)

00546 Hot pressing, strength, and fracture of calcium hexaboride. Dutta, S.K. (Materials and Mechanics Research Center, Watertown, MA). *Am. Ceram. Soc. Bull.*; 54: No. 8, 727-728(Aug 1975).

From 75. Annual meeting of the American Ceramic Society; Cincinnati, OH (1 May 1973).

Fracture behavior and strength of hot-pressed CaB_6 were studied. The modulus of elasticity determined by attaching strain gages to the tensile surface of the bend bars to measure strain, was 55 +- 3 x 10^6 psi. The results are compared with values for other low density ceramic materials (B_4C, SiB_6, Be_4B, AlB_{12}) in a table. The fracture mode was observed for both modulus of rupture and impact test specimens. Predominantly transgranular fracture, associated with distinct step cleavages is evident. Fracture origins were examined in an effort to understand the strength limiting features in hot-pressed CaB_6 specimens. Surface defects, large grain agglomerations, and isolated pore pockets were observed and varied from bar to bar; these were similar to those found in B_4C. (auth)

PHYSICAL PROPERTIES

00547 (SLA—74-0157) **Compatibility of dielectric and heat shield material combinations during ablations.** Mead, K.E.; Sheldahl, R.E.; Wright, G.F. (Sandia Labs., Albuquerque, N.Mex. (USA); Sandia Labs., Livermore, Calif. (USA)). Jul 1975. Contract AT(29-1)-789. 41p. Dep. NTIS $5.25.

The surface recession and mass-transfer rates of materials suitable for reentry thermal protection of microwave antennas have been examined. Experiments were performed with subsonic-turbulent flow of air in a confined channel. In supporting experiments, selected material combinations were subjected to ablative splash tests in the Sandia High Enthalpy Arc Tunnel. Microwave window materials were tested adjacent to ablative heat shield materials in combinations and configurations under consideration for reentry vehicle applications. Test results indicated that fused silica was compatible with quartz-phenolic and carbon-phenolic heat shield materials while the ablative characteristics of hot-pressed boron nitride were very similar to those of the STC-7 carbon composite developed by Sandia Laboratories. (auth)

00548 Alkali metal polytungstate phosphors containing europium. Kernohan, J.A. (to General Electric Co.). US Patent 3,881,941. 6 May 1975. Filed date 1 Oct 1973. 6p.

A particular class of alkaline metal polytungstate materials containing europium have been found to be superior in their emission response of converting UV radiation to visible light when compared with conventional phosphors. These phosphors are crystalline solids wherein the europium ion is contained in a particular polytungstate structure, and exhibit phosphorescence when excited by a source of 2537-A radiation which makes them especially useful in photodetection systems. (Official Gazette)

00549 Temperature and pressure dependences of the properties and phase transition in paratellurite (TeO_2): ultrasonic, dielectric, and Raman and Brillouin scattering results. Peercy, P.S.; Fritz, I.J.; Samara, G.A. (Sandia Labs., Albuquerque, NM). *J. Phys. Chem. Solids;* 36: No. 10, 1105-1122(Oct 1975).

The effects of temperature and pressure on the ultrasonic propagation properties, dielectric constants, and the Raman and Brillouin spectra in paratellurite (TeO_2) were investigated with emphasis on the behavior in the vicinity of newly-discovered, pressure-induced phase transition. The transition is found to be second-order and purely strain-induced, driven by a soft shear acoustic mode propagating along a (110) and polarized along a (1 anti 10) crystal direction. No evidence was found for any coupling of the soft mode to any other acoustic or optic mode, although small anomalies associated with lattice strains accompanying the transition were observed in some of the elastic and dielectric constants. Analysis of the effective elastic constant C′ governing the soft mode velocity indicates that, within experimental uncertainty, the transition can be described by mean-field theory. With the exception of C_{44}, the remaining elastic constants and Raman-active phonon frequencies displayed normal increases with pressure. No soft Raman-active modes were observed in either phase. The static dielectric constants epsilon/sub i/ are large, due to the large electronic polarizability of TeO_2, and the anisotropy in epsilon results almost entirely from the anisotopy in the optical dielctric constants epsilon/sub infinity/.In the low pressure tetragonal phase both epsilon/sub a/ and epsilon/sub c/ exhibit normal temperature dependences and epsilon/sub c/ decreases with pressure. Temperature, pressure and uniaxial stress measurements are combined to evaluate the various contributions to the temperature and pressure dependences of epsilon. Combining the epsilon data with available i.r. measurements demonstrated that the generalized Lyddane--Sachs--Teller relation is well obeyed for TeO_2. Szigetti effective charge ratios were found to be quite low, being 0.27 and 0.18 for the α-axis responses, respectively, indicating that the bonding is highly covalent. (auth)

CORROSION AND EROSION

00550 High-temperature oxidation behavior of a HfB_2 + 20 v/o SiC composite. Hinze, J.W. (Systems Research Labs., Inc., Dayton, OH); Tripp, W.C.; Graham, H.C. *J. Electrochem. Soc.*; 122: No. 9, 1249-1254(Sep 1975).

The high-temperature oxidation behavior of a HfB_2 + 20 vol percent SiC composite was investigated in the temperature range 1200 to 1550°C and in oxygen partial pressures at 1400°C ranging from 2.6 x 10^{-9} to 3.3 x 10^{-1} atm. Oxidation kinetics in pure oxygen were parabolic, with the rate constants exhibiting linear Arrhenius behavior. The rate of oxygen consumption is described by k/sub p/ = 1.62 x 10^{7} exp (-106,000/RT) g^2-cm^{-4}-hr^{-1} in the range 1350 to 1550°C. The oxide scale formed in this range consisted of an inner HfO_2 layer in series with an outer SiO_2 layer. The oxidation rate was found to be controlled by initial short-circuit oxygen diffusion through the HfO_2, followed by volume diffusion through the SiO_2 scaling layer. Below 1350°C, rapid oxidation kinetics were observed, HfO_2 being the primary scale constituent. (auth)

RADIATION EFFECTS

00551 (BNWL-SA—5440) **Chimera of new nuclear materials.** Bush, S.H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. 67p. (CONF-750644—4). Dep. NTIS $6.50.

From Annual conference of the American Society for Engineering Education; Ft. Collins, Colorado, USA (16 Jun 1975).

The current and future needs in materials for light water reactors and liquid metal fast breeder reactors are reviewed. Information and discussions are included on boiling water reactors, pressurized water reactors, liquid metal fast breeder reactors, corrosion of piping systems and steam generators, ferritic steels, stainless steels, Inconel 600, pressure vessels, and radiation damage. (JRD)

00552 (UCLA—34P172-16) **Irradiation-induced precipitation in Ni—Si alloys.** Barbu, A.; Ardell, A.J. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jul 1975. Contract E(04-3)-34. 10p. Dep. NTIS $4.00.

The microstructures of Ni^+ ion-irradiated Ni—Si solid-solution alloys, containing 2, 4, 6 and 8 at. percent Si were investigated as a function of dose, dose-rate, and temperature. Results of transmission electron microscopy and other data show the precipitation of γ' (Ni_3Si) in all samples irradiated at 500°C. Characteristics of the precipitates are described and a mechanism for their formation is suggested. (auth)

00553 **Cause of loss of hydrogen-overvoltage on graphite electrodes used for anodic stripping voltammetry.** Clem, R.G. (Univ. of California, Berkeley). *Anal. Chem.*; 47: No. 11, 1778-1784(Sep 1975).

Work with neutron-damaged graphites shows conclusively that structure is not the cause of anodic stripping voltammetry (ASV) electrode failure. Mercuric and especially trace silver-ion strongly catalyze the oxidation of the graphite electrode surface with the result that graphite oxides are formed. Formation of carboxyl groups are the likely cause of loss of hydrogen overvoltage. Electrode behavior after treatment with vacuum ultraviolet light, diazomethane, lithium aluminum hydride, dimethylmercury, various amines, and propylene oxide is described. (auth)

COMPOSITE MATERIALS

MECHANICAL PROPERTIES

00554 (UCRL—51868) **Shock compression parameters for a boron-loaded, silicone-rubber composite.** Gust, W.H.; Van Thiel, M.; Gathers, G.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jul 1975. Contract W-7405-Eng-48. 12p. Dep. NTIS $4.00.

Hugoniot parameters under uniaxial-shock-wave-loading from 0.03 to 0.6 Mbar are presented for a composite with 70 wt percent boron loaded in a silicone-rubber matrix. The plot of shock velocity vs particle velocity was found to be nonlinear. Equations that describe fits of the data are presented. (auth)

OTHER MATERIALS

STRUCTURE AND PHASE STUDIES

00555 (SAND—75-5309) **Electron microprobe study of the homogeneity of silicon—germanium alloys.** Chambers, W.F. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 13p. (CONF-750652—1). Dep. NTIS $4.00.

From 8. international metallographic society conference; Minneapolis, Minnesota, USA (29 Jun 1975).

This study provided an important guide for the necessary materials process development for the thermoelectric generator elements for radioisotope batteries. The final process utilized the technique of vacuum hot-pressing reduced, chill-cast material for producing silicon-germanium ingots. Although this material was not as homogeneous as zone-leveled ingots, it was more dense (greater than 99 percent of theoretical) and was considerably easier, quicker, and cheaper to manufacture. Throughout the production of this material, electron microprobe homogeneity traverses were made on random samples to provide quality control. The availability of quantitative traces provided a means of measuring on an absolute basis the deviation from stoichiometry of any given alloy grain. In other applications, it was possible to use such traces to identify phases or to determine concentration gradients across phases. (auth)

PROPERTIES

00556 (ORNL-TM—4504) **Graphitization kinetics of fluidized-bed pyrolytic carbons.** Beatty, R.L. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. 211p. Dep. NTIS $13.75.

Thesis. Submitted to Univ. of Washington, Seattle.

Graphitization of 12 fluidized-bed pyrocarbons was studied as a function of heat-treatment time and temperature (1350 to 3000°C) to investigate the effect of initial microstructure on the graphitization process. The term "graphitization" is defined to include any thermally induced structural change, whether or not any layer stacking order is attained. A broad range of CVD microstructures was prepared at temperatures from 1150 to 1900°C and various propylene and methane concentrations. The twelve carbons spanned a wide range of graphitizabilities, primarily as a function of deposition temperature. Hydrocarbon concentration was of much less importance except for deposition at 1900°C. Hydrogen content of the as-deposited carbons decreased with increasing temperature of deposition, and initial graphitization behavior of the low-temperature carbons appeared to be related to hydrogen content and evolution. Rates of change in the parameters varied widely throughout the range of heat-treatment times (HTt) and temperatures (HTT) for the different carbons showing differences between the more graphitizable or "soft" carbons from the nongraphitizing or "hard" carbons. ΔH for nongraphitizing carbons was 175 +- 15 kcal below 1950°C, 240 +- 35 kcal at 1950 to 2700°C, and 330 +- 20 kcal above 2700°C. For graphitizing carbons deposited at 1150°C, values near 245 kcal were obtained from anti chi data for the HTT range 1350 to 1650°C, while densification data yielded values of about 160 kcal in the same range. The behaviors observed for graphitizable carbons above 2000°C are consistent with literature. Different kinetic behaviors below 2000°C were shown to be due to different initial microstructures as well as to different parameters measured. (DLC)

00557 (UCRL—51862) **Multiphonon relaxation and excitation transfer in rare-earth doped glasses.** Layne, C.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Jul 1975. Contract W-7405-eng-48. 64p. Dep. NTIS $5.45.

Thesis.

The theory of multiphononon relaxation for rare-earth ions in crystals is extended to nonradiative relaxation in glasses. The expected exponential dependence of the multiphonon rates on energy gaps was verified for 5 oxide glass compositions; the active phonons were identified to be the high-energy molecular vibrations of the network forming ions. The multiphonon rates are determined by the highest phonon energies, with the rates in borate glasses being 10^3 times these in tellurite glasses; they are much faster than in crystals. Coupling of the rare earth to phonons is relatively constant in oxide glasses, but may vary in halide or chalcogenide glasses. The influence of nonradiative rates on the performance of a Nd : glass laser is assessed, with the theory being verified. Energy transfer in Nd : glass accounts for the observed nonexponential fluorescence decay of excited Nd ions. Coupling between Nd ions is due to dipole-dipole interaction. Lifetime decreases with Nd content. Results can be used to predict the fluorescent behavior and performance of new laser glasses. Energy transfer from Ce to Nd in laser glass was observed. (DLC)

RADIATION EFFECTS

00558 (BNL—20253) **Radiation induced coloring of glasses measured during and after electron irradiation.** Swyler, K.J.; Hardy, W.H. II; Levy, P.W. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 13p. (CONF-750703—13). Dep. NTIS $4.00.

From IEEE annual conference on nuclear and space radiation effects; Arcata, California, USA (14 Jul 1975).

The growth of color centers during irradiation, and the decay after irradiation, were studied in two glasses using recently developed equipment for making optical absorption and luminescence measurements during and after electron irradiation. The glasses studied were NBS 710, a soda-lime silicate glass, and NBS 711, a lead silicate glass. Both glasses exhibit similar coloring

characteristics. The radiation-induced absorption spectra consists of a weak gaussian shaped band in the visible, a stronger gaussian band in the ultraviolet, and a band edge "shift" which may be accurately approximated by a third gaussian band. For all absorption bands, the color center vs dose (or irradiation time) curves can be accurately resolved into two saturating exponential and one linear component. The decay curves obtained after the irradiation is terminated can be accurately expressed by three exponential components. Coloring and decay curves made at different dose rates indicate that the processes responsible for decay after irradiation and electron hole recombination during irradiation play important roles in determining the rate and extent of coloring. Results are qualitatively in agreement with some very simple kinetic treatments for color center formation. In some, but not all, respects the quantitative agreement is also good. Lastly, the results indicate that it is necessary to make measurements during irradiation to establish the formation kinetics of color centers that are unstable at the bombardment temperature. (auth)

00559 (CONF-750714—1) **Effects of fast-neutron damage from 0 to 42 x 10^{21} neutrons/CM^2 on the physical properties of near-isotropic grades of graphite.** Cook, W.H.; Kennedy, C.R.; Eatherly, W.P. (Oak Ridge National Lab., Tenn. (USA)). 1975. 5p. Dep. NTIS $4.00.

From 12. biennial conference on carbon; Pittsburgh, Pennsylvania, USA (28 Jul 1975).

The characterization of property changes in various grades of near-isotropic, "binderless" grades of graphite as functions of fluence accumulated at 715°C from 0 to 42 x 10^{21} neutrons/cm^2 (E greater than 50 keV) was made. Generally, the average coefficients of thermal expansion (CTE) from 20 to 600°C and the room-temperature values for strengths, fracture strains, Young's moduli, shear moduli, and calculated figures of merit (FOM) for resistance to thermal shock all ultimately decreased with fluence. (auth)

00560 (GERHTR—131) **Changes in dimensions, modulus of elasticity and thermal conductivity due to regraphitization caused by neutron irradiation.** Delle, W. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). 26 Apr 1974. Translation of a paper presented at spring meeting of the Carbon Working Party of the German Ceramics Society. 16p. Dep. NTIS $4.00.

Work performed under United States—German High Temperature Reactor Research Exchange Program.

In addition to the radiation damage, a radiation-induced graphitization (re-ordering of poorly ordered areas) occurs during neutron irradiation of graphite. The competing influence of both effects is discussed with a view to the changes of dimensions, of E-module, and of heat-conductivity. (GE)

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

00561 (CONF-750646—1) **Defining and determining the significance of impacts: concepts and methods.** Christensen, S.W.; Van Winkle, W.; Mattice, J.S. (Oak Ridge National Lab., Tenn. (USA)). 1975. 71p. Dep. NTIS $6.75.

From Workshop on the biological significance of environmental impacts; Ann Arbor, Michigan, USA (4 Jun 1975).

The term impact is conceptually and mathematically defined to be the difference in the state or value of an ecosystem with versus without the source of impact. Some resulting problems associated with the measurement of impacts based on comparisons of baseline and operational data are discussed briefly. The concept of a significant adverse impact on a biological system is operationally defined in terms of an adverse impact which, according to a proposed decision-tree, justifies rejection of a project or a change in its site, design, or mode of operation. A gradient of increasing difficulty in the prediction of impacts exists as the scope of the assessment is expanded to consider long-term, far-field impacts with respect to higher levels of biological organization (e.g., communities or ecosystems). The analytical methods available for predicting short-term, near-field impacts are discussed. Finally, the role of simulation modeling as an aid to professional judgment in predicting the long-term, far-field consequences of impacts is considered, and illustrated with an example. (auth)

ACTIVATION AND NUCLEAR REACTION PROCEDURES

00562 (ANL—8153, pp 57-59) **Geo- and cosmochemistry and archaeology.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Lunar samples were analyzed by fast-neutron, slow-neutron, and photon-activation for F, Cl, Br, I, U, Li, Te, Hg, Ru, Os, ^{204}Pb, Bi, Tl, and Zn. In mineralogical studies, the distribution of U, Th, Ba, and the rare earths in the calcium—aluminium-rich inclusions in the Allende meteorite was studied by analyzing 15 Allende inclusions using neutron activation methods. (LK)

00563 (CONF-741001—, pp 557) **Microcomputer-based systems for automatic control of sample irradiation and chemical analysis of short-lived isotopes.** Bourret, S.C. (Univ. of California, Livermore). 1974.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Cube symposium, Lawrence Livermore Laboratory, October 23—25, 1974. Symposium proceedings.

Two systems resulted from the need for the study of the nuclear decay of short-lived radionuclides. Automation was required for better repeatability, speed of chemical separation after irradiation and for protection from the high radiation fields of the samples. A MCS-8 computer was used as the nucleus of the automatic sample irradiation system because the control system required an extensive multiple-sequential circuit. This approach reduced the sequential problem to a computer program. The automatic chemistry control system is a mixture of a fixed and a computer-based programmable control system. The fixed control receives the irradiated liquid sample from the reactor, extracts the liquid and disposes of the used sample container. The programmable control executes the chemistry program that the user has entered through the teletype. (auth)

00564 (LA-UR—75-1331) **Neutron measurements of ^{234}U isotopic abundance in UF_6 samples.** Stieff, L.R.; Walton, R.B.; Reilly, T.D.; Fields, L.W.; Walker, R.L.; Mullins, W.T.; Thoms, J.I. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 16p. (CONF-750608—11). Dep. NTIS $4.00.

From Annual meeting of the institute of nuclear materials management; New Orleans, Louisiana, USA (18 Jun 1975).

Neutrons produced from the (α,n) reaction on fluorine were used to measure the ^{234}U isotopic abundance in UF_6 samples. A 4PI detector consisting of 14 ^3He counters embedded in a polyethylene anulus was specifically designed to receive standard 1S (high-enriched) and 2S (low-enriched) UF_6 sample cylinders. The ^{235}U isotopic abundances of the 19 2S and 5 1S samples studied range from 0.30 to 4.0 percent (wt) and 80.0 to 97.7 percent (wt) respectively. A typical net weight for the UF_6 in the 1S cylinders is 800 g and in 2S cylinders is 1700 g. For counting times of 10^3 sec and for ^{234}U concentrations over a range of 0.001 to 1.0 percent (wt), the neutron method will achieve accuracies better than 2.5 percent (1 sigma) for the depleted and low-enriched UF_6 and approximately 0.5 percent (1 sigma) for the high-enriched UF_6 when compared with the ^{234}U isotopic abundances obtained using a high precision, two-stage mass spectrometer. Extension of the ^{234}U neutron assay method to samples containing ^{232}U is now being investigated. From these preliminary results it appears that the isotope separation plant operator and the safeguards inspector should be able to use this new nondestructive assay technique for precision measurements of the isotopic abundance of ^{234}U. In addition, the method could be useful as an indirect field method for ^{235}U assay where gamma techniques give inconclusive results and where the $^{235}U/^{234}U$ ratio can be assumed or has been previously established either by measurement or calculation. (auth)

00565 (UCRL—51850) **Trace elements in California aerosols. Part I. Instrumental neutron activation analysis techniques.** Ragaini, R.C.; Ralston, H.R.; Garvis, D.; Kaifer, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jun 1975. Contract W-7405-Eng-48. 46p. Dep. NTIS $4.00.

Instrumental Neutron Activation Analysis (INAA) done at LLL played a key role in the 1972—1974 California Aerosol Characterization Experiment (ACHEX), a major experiment in the chemistry of aerosols in urban and non-urban sites of California sponsored by the State of California Air Resources Board. The main purpose of INAA was to measure the particle size distributions and diurnal patterns of key chemical constituents in aerosols collected in California. These data were used to satisfy some of the key objectives of ACHEX, including aerosol characterization and evaluation of the origins and evolutions of aerosols. Secondary uses of INAA were the validations of the Lundgren rotating drum cascade impactors used in the ACHEX, and validations of other analytical techniques used in the chemical analyses. As a result of these studies, it was concluded that techniques using INAA were

useful operational methods for chemical analysis of aerosols collected over two-hour periods in urban air with an active monitoring program. (auth)

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

00566 (CONF-720805—P1, pp 181-231) **High-resolution gamma ray spectrometry for laboratory analysis of the uranium and thorium decay series.** Smith, A.R.; Wollenberg, H.A. (Univ. of California, Berkeley). 1972.

From 2. conference on natural radiation environment; Houston, Texas, USA (7 Aug 1972).

Natural radiation environment II.

Experimental data and results obtained with a Ge(Li) spectrometer system are discussed including studies of the uranium series and the thorium series, with emphasis on spectral evidence for disequilibrium conditions. A study of the problem of U-content of the Th-standard provided by the USAEC New Brunswick Laboratory (NBL) is described and an obvious solution is presented. Examples of U and Th analyses of relatively high activity materials, including comparisons with NaI(Tl) spectrometric determinations are included. The reasonable lower limits of U and Th concentrations that can be successfully measured with such a system and the necessity for digital computer processing of this type data in order to extract all the information required for the analysis procedures described are discussed. Data on the decay series of ^{238}U, ^{235}U, and ^{232}Th are included and recent data on the energies and intensities of some γ-transitions are also included. (CH)

00567 (COO—3040-4) **Design and construction of a detection system for the determination of lead in blood using x-ray fluorescence analysis. Progress report, August 1, 1974—July 31, 1975.** Laurer, G.R.; Kneip, T.J. (New York Univ., N.Y. (USA). Medical Center). 1975. Contract AT(11-1)-3040. 21p. Dep. NTIS $4.25.

Intercomparison difficulties between x-ray fluorescence (XRF) and atomic absorption (AA) measurements of blood lead were due to weight variations in the samples which are correlated to the hemoglobin content. Correction factors were developed to account for changes in background and sensitivity due to weight and hence hemoglobin content variations. Good agreement was achieved in comparisons of XRF and AA determinations on baboon blood, and a preliminary intercomparison with the New York City Health Department demonstrated that the corrected XRF values are accurate for children's blood. The XRF system can accurately determine blood lead concentrations in the range of 0.1 to 3.0 ppM. The difference in the content of zinc in the urine of two individuals undergoing chelation therapy was determined, using XRF analysis, on samples taken before and after treatment. The ratio of the count rate under the Zn K/sub alpha/ peak for one of these persons after treatment was 250 : 1, compared to before chelation. (auth)

SEPARATION PROCEDURES

00568 (ANL—8153, pp 7-17) **Separations and environmental chemistry.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Progress in research on high-speed radiochemical separations by liquid-liquid chromatography is reported. Results of the separation of Am(III) and Cm(III) and the separation of Bk(III) and Cf(III) are given. Application of liquid-liquid extraction to disposal of reactor waste is considered. In the study on the behavior of plutonium and americium in rock strata, the major research effort was aimed at evaluating techniques of measuring the parameters relevant to the migration of the two elements. (LK)

00569 (BM-RI—7990) **Recovery and separation of rare-earth elements, barium, and strontium from bastnasite with sulfuric acid.** Eisele, J.A.; Bauer, D.J. (Bureau of Mines, Reno, Nev. (USA). Reno Metallurgy Research Center). 1974. 13p. Dep. NTIS $4.00.

A bench-scale investigation was made of a concentrated H_2SO_4 reaction for recovering and separating rare earth elements, barium, and strontium from a bastnaesite ore and byproduct. Barium and strontium were dissolved in the concentrated acid and precipitated as a mixed product by water dilution. Separation of strontium from barium was effected by reaction with Na_2CO_3 solution, followed by a dilute acid leach of the $SrCO_3$ formed. After removing the barium and strontium from bastnaesite ore, the rare-earth elements were roasted to water-soluble sulfates. The rare earth sulfate solution was subsequently processed by solvent extraction to produce rare-earth oxides low in lead and magnesium. (auth)

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

00570 (ANCR—1217) **Explosive hazards analysis of the eutectic solution NaK and KO_2.** Commander, J.C. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jun 1975. Contract AT(10-1)-1375. 43p. Dep. NTIS $4.00.

Planning, preparation, conductance, and evaluation of field tests are reported to determine the explosive hazards associated with the combining of the sodium-potassium eutectic alloy (NaK) with the superoxide of potassium (KO_2) under various conditions of state, contamination, and detonation initiation. The planning and preparation was conducted by Aerojet Nuclear Company (ANC) at the Idaho National Engineering Laboratory, and the explosive hazards testing was done by Cook Associates, Inc., at IRECO Chemicals Pelican Point Research and Development facility in Utah. The test results showed that binary combinations of pure NaK and KO_2 could not be made to detonate, although the mixtures will spontaneously ignite and burn. However, tertiary combinations of NaK, KO_2 plus a water or hydrocarbon contaminant produced explosive hazards under a variety of conditions. The work was performed as part of the Decontamination and Decommissioning (D and D) of the first Experimental Breeder Reactor (EBR-I) and was funded by 189c I-215. (auth)

00571 (ANL—8153, pp 96-107) **Stable-isotope studies.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Structures of bacteriochlorophyll b and the Krasnovskii photoreduction products of chlorophyll a are given. All 55 ^{13}C and 4 ^{15}N NMR transitions in chlorophyl a and its magnesium-free derivative pheophytin a were assigned. ESR of triplet states of chlorophylls a, b, c/sub z/, and c_s and bacteriochlorophyll a are reported. Experiments in the cultivation of ^{13}C-enriched morning glory plants indicated that the isotope enrichment can produce observable morphological changes. (LK)

00572 (ANL—8153, pp 133-144) **Structural chemistry.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

In studies on the chemistry of irradiated fuels the structure-determination of $Cs_2Mo_3O_7$ is now complete. Structural studies of β-U_3O_8 and U_2F_9 are continuing. Major accomplishments in neutron crystallography include a neutron-structure study of $K_2Pt(CN)_4Br_{0.30} \cdot 3H_2O$ and discovery of the HgO_4^+ ion and a nearly symmetric $H_5O_2^+$ ion coexisting in the same crystal ($H_2PtCl_6 \cdot 6H_2O$). In the first study of its kind a symmetric, single-minimum, bent Mo—H—Mo bond was found in a complex hydrido dicarbonyl molybdenum complex by means of single crystal neutron analysis. (LK)

00573 (ANL—8153, pp 178-182) **Applied programs.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Products of thermal and chemical degradation of coal were studied. Isotopic fractionation effects for atmospheric CO were determined. Lunar material was searched for quarks and laser chemistry is being investigated. (MCG)

00574 (BM-RI—7986) **Electrochemical anodic reaction rate of vanadium metal with molten VCl_3—VCl_3—NaCl mixtures.** Raddatz, A.E.; MacDonald, D.J. (Bureau of Mines, Reno, Nev. (USA). Reno Metallurgy Research Center). 1974. 12p. Dep. NTIS $4.00.

The electrochemical rate of anodic dissolution of vanadium metal in a VCl_2-VCl_3-NaCl electrolyte at 860°C was determined to elucidate the reaction mechanism. Rate measurements were carried out with the help of specially designed equipment capable of continuously recording the weight loss experienced by a cylindrical vanadium anode immersed in the molten salt electrolyte while a constant current is maintained through it. The rate is expressed as a function of current density and VCl_2 concentration, and the reaction is interpreted in terms of an adsorption mechanism. Multiple regression analysis of the data gave the following rate equation: Rate x 10^4 ($g \cdot cm^{-2} \cdot sec^{-1}$) = -0.38 + 2.64 current density (amp . cm^{-2}) + 0.69 log/sub e/ (mole-percent VCl_2). (auth)

00575 (UCID—16834) **Lithium "super hydride".** Leider, H.R.; Lakner, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jul 1975. Contract W-7405-Eng-48. 14p. Dep. NTIS $4.00.

Experiments at Lawrence Livermore Laboratory attempting to produce LiH/sub (1+X) are discussed. Since none of the attempts gave any convincing evidence of its existence, the experimental survey was terminated. (CK)

ISOTOPE EFFECTS

00576 (ANL—8153, pp 183) **Utilization of special facilities.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Isotope separation applications are briefly reported. (LK)

ORGANIC CHEMISTRY

ISOTOPE EFFECTS

00577 **Quantitative analysis of carbon—carbon coupling in the ^{13}C nuclear magnetic resonance spectra of molecules biosynthesized from ^{13}C enriched precursors.** London, R.E.; Kollman, V.H.; Matwiyoff, N.A. (Los Alamos Scientific Lab., NM). *J. Am. Chem. Soc.*; 97: No. 13, 3565-3573(25 Jun 1975).

The quantitative dependence of the intensities of the various multiplet lines arising from ^{13}C-^{13}C nuclear spin coupling as a function of ^{13}C enrichment is considered. Two cases are distinguished, depending on whether or not the enrichment of the interacting carbons is statistically independent. For statistically independent labeling, the splitting is simply related to the enrichment of the various carbons. For cases in which this condition does not hold, the splitting provides a measure of the correlation in the enrichment of interacting carbons. The quantitative analysis of ^{13}C-^{13}C coupling is shown to provide additional information in biosynthetic experiments in which a correlation in the labeling of the substrates is introduced. In contrast to the information which is obtained by looking for the incorporation of a label into a specific position of a biosynthesized molecule, a quantitative analysis of the correlation in the labeling of the product can give information about the direct incorporation of more complex structural units. Three examples are discussed: the glycolysis of glucose to lactate, the biosynthesis of galactosylglycerol by species of red algae, and the use of doubly labeled acetate to study the biosynthetic incorporation of acetate units into more complex molecules. (auth)

RADIATION CHEMISTRY

00578 (ANL—8153, pp 70-89) **Radiation chemistry and photochemistry.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Progress is reported in two of the areas made accessible by picosecond pulse radiolysis. The chemical history of the hydrated electron in the spur has been determined, and reactions of the hydrated electron with high concetration of solute have been measured and explained. Other studies reported on are initial work of heavy-ion pulse radiolysis and nonequilibrium spin populations in radicals. In the area of pulse radiolysis of gases progress is reported in studies on reactions of the hydroxyl radical, production of the OH radical in hydrocarbon—oxygen systems, reaction of chlorine atoms and and chlorinated radicals, reaction of CN with H_2, and mechanisms of excited state formation. (LK)

00579 (BNL—20210) **Physical principles of thermoluminescence and recent developments in its measurement.** Levy, P.W. (Brookhaven National Lab., Upton, N.Y. (USA)). 1974. 18p. (CONF-7409128—1). Dep. NTIS $4.00.

From International seminar on applications of science to dating of works of art; Boston, Massachusetts, USA (23 Sep 1974).

The physical principles which are the basis of thermoluminescence techniques for dating and authenticating archaeological and fine art objects are described in non-technical terms. Included is a discussion of the interaction of alpha particles, beta rays, i.e., energetic electrons, and gamma rays with solids, particularly electron-hole ion pair formation, and the trapping of charges by crystal imperfections. Also described is the charge-release process induced by heating and the accompanying emission of luminescence resulting from charge recombination and retrapping. The basic procedure for dating and/or authenticating an artifact is described in a "how it is done" manner. Lastly, recently developed apparatus is described for simultaneously measuring luminescent light intensity and wavelength and sample temperature. Examples of studies made with this "3-D" apparatus are given and applications to dating and authenticating are described. (auth)

00580 (CONF-750549—1) **Ionizing radiation induced attachment reactions of nucleic acids and their components.** Myers, L.S. Jr. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1975. Contract AT(04-1)-GEN-12. 42p. Dep. NTIS $5.25.

From International symposium on protein and other adducts to DNA; Williamsburg, Virginia, USA (2 May 1975).

An extensive bibliographic review is given of experimental and theoretical data on radiation-induced attachment reactions of nucleic acids and their components. Mechanisms of these reactions are reviewed. The reactions with water, formate, and alcohols, with amines and other small molecules, and with radiation sensitizers and nucleic acid-nucleic acid reactions are discussed. Studies of the reaction mechanisms show that many of the reactions occur by radical-molecule reactions, but radical-radical reactions also occur. Radiation modifiers become attached to nucleic acids in vitro and in vivo and there are indications that attachment may be necessary for the action of some sensitizers. (JSR)

00581 (COO—3126-31) **Nuclear and radiochemical techniques in chemical analysis. Progress report, 1 June 1974—31 May 1975.** Finston, H.L.; Williams, E.T. (Brooklyn Coll., N.Y. (USA). Dept. of Chemistry). 1975. Contract E(11-1)-3126. 39p. Dep. NTIS $5.00.

Progress on the project to determine the neutron-absorption cross section of ^{22}Na is described. Upper limits for the thermal-neutron cross sections of ^{88}Y and ^{139}Ce have been set at 100 barns. The experiment to search for a change in the ratio of electron capture to positron emission due to difference in chemical environment is underway. The mechanical aspects of the system for analysis by proton-induced x-ray emission are described. Recent results on solvent extraction of mercury by pure solvents and propylene carbonate are described. Recent measurements in a study of an acid-base hypothesis are described. (auth)

00582 (COO—3221-33) **Catalytic mechanism of the manganese containing superoxide dismutase of escherichia coli studied by pulse radiolysis technique. Progress report, 1 September 1974—1 July 1975.** Pick, M.; Rabani, J.; Yost, F.; Fridovich, I. (Hebrew Univ., Jerusalem (Israel); Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F.R. Germany); Duke Univ., Durham, N.C. (USA)). 1975. Contract AT(11-1)-3221. 22p. Dep. NTIS $4.25.

The dismutation of O_2^-, catalyzed by E. coli Mn dismutase has been investigated. O_2^- was generated in formate aqueous solutions by pulse radiolysis. When the initial concentration of O_2^-, $[O_2^-]_0$ is less than 10 times the total concentration of the dismutase, $[E]_0$, a reaction first order in both $[O_2^-]$ and $[E]_0$ is observed, the apparent reaction rate constant of which is $(1.5 \pm 0.15) \times 10^9$ M^{-1} sec^{-1}. When $[O_2^-]_0/[E]_0$ greater than 15, a biphasic process is observed. Under these conditions only about 15 O_2^- radical ions per each dismutase molecule react with a relatively fast rate. Excess O_2^- is removed by a less efficient reaction, also first order in $[E]_0$ and nearly first order in $[O_2^-]$, which has an apparent rate constant $(1.6 \pm 0.25) \times 10^8$ M^{-1} sec^{-1}. The results are interpreted in terms of four oxidation and reduction reactions. (auth)

00583 (COO—3416-20) **Radiation chemistry and mass spectrometry of volatile silanes and germanes. Progress report, June 1, 1974—May 31, 1975.** Lampe, F.W. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 1975. Contract E(11-1)-3416. 23p. Dep. NTIS $4.25.

Status of the following studies is reported: ion-molecule reactions in silane and organosilane systems; long-lived intermediate complexes in the reaction of silyl ions with ethylene; the bimolecular reaction of silyl radicals; formation of disilane in the D-atom induced decomposition of monosilane; reaction of silyl radicals with acetone; and radiolysis of monosilane-nitric oxide mixtures. (LK)

00584 (ORO—3106-54) **Radiation chemistry of hydrocarbon and alkyl halide systems. Progress report, 1 July 1974—31 July 1975.** Hanrahan, R.J. (Florida Univ., Gainesville (USA). Dept. of Chemistry). 1975. Contract AT(40-1)-3106. 26p. Dep. NTIS $4.50.

In the study of gas phase radiolysis of C_2F_6—C_2H_6 mixtures, the effect of 10 percent added oxygen on major products of the radiolysis in the pure fluorocarbon, pure hydrocarbon, and five intermediate compositions was measured. Work on gas phase radiolysis and photolysis of ethyl bromide was completed. Identification of major and minor products from the gamma radiolysis of C_2F_5I and quantitative measurement of radiolytic yields is nearly complete. Quantitative experiments on the radiolysis of CF_3I have not yet been accomplished, but identification of major and minor radiolysis products is complete. Results from the gamma radiolysis of tetrafluorocyclobutane are presented. (LK)

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

00585 (ANL—8153, pp 1-6) **Heavy-element research.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

The status is reported of studies on the solid-state chemistry of the actinides and lanthanides, spectroscopy of actinide compounds, and dynamic chemical description of actinide elements in solution. Phase studies were done on Rb_2UO_4, K_2UO_4, Li_2UO_4, and Es_2U_2O. The lithium neptunate (VI) system was investigated and the existence of Li_2NpO_4 was established. In oxidation-reduction studies it was shown that Am(III) can be electrolytically oxidized to Am(IV) in strong H_3PO_4, but Cf(III) and Pr(III) do not oxidize. The low-temperature absorption spectrum of thin films of $NpBr_3$ was investigated. (LK)

00586 (ANL—8153, pp 108-116) **High-temperature chemistry.** Thorn, R.J.; Ackermann, R.J.; McCreary, J.R.; Rauh, E.G.; Winslow, G.H. Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Photoelectron spectra for NdF_3, SmF_3, EuF_3, TmF_3, and YbF_2 and YbF_3 in the 4f region are reported. The point-defect model of uranium has been refined numerically and used exhaustively for predicting properties of hypostoichiometric urania in addition to oxygen partial pressures and total pressures of uranium-bearing species. The structural behavior of the nonstoichiometric U_2O/sub 8-z/ phase was elucidated by gravimetric, thermodynamic, and high-temperature x-ray studies. The entropies and enthalpies of sublimation of FmF_3, LuF_3, CsF_3, NdF_3, PrF_3, GdF_3, TbF_3, DyF_3, HoF_3, and ErF_3 were determined. The thermodynamic properties of ZrO(g) and HfO(g) were determined by mass-spectrometric studies of five isomolecular oxygen-exchange reactions. (LK)

00587 (ANL—8153, pp 117-122) **Low-temperature calorimetry.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Heat capacity, standard entropy, standard enthalpy, and standard Gibbs energy of $^{242}PuF_4$ from 10 to 350°K, of $^{244}PuO_2$ from 4 to 25°K, of Li_3N from 5 to 350°K, and of Cs_2UO_4 from 5 to 350°K are reported. (LK)

00588 (ANL—8153, pp 145-148) **Molecular spectroscopy.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Spectroscopic studies of lanthanide, actinide, and transition-metal complexes were done to provide a better understanding of the nature of binding in these complexes, and, in the case of the transition-element complexes, of the pressure effects on structural and spin-state conversions. (LK)

00589 (ANL—8153, pp 127-132) **Inorganic chemistry.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Two compounds (O_2SbF_6 and IF_6SbF_6) were tested as chemical reagents for trapping the heavier noble gases (isotopes of radon and xenon) released to the atmosphere by nuclear power plants and fuel reprocessing plants. Results on the Raman scattering of anhydrous liquid HF are reported. (LK)

00590 (CONF-750913—4) **Structure and bonding in compounds containg the NpO_2^+ and NpO_2^{2+} ions.** Musikas, C.; Burns, J.H. (Oak Ridge National Lab., Tenn. (USA)). 1975. 17p. Dep. NTIS $4.00.

From 4. international transplutonium elements symposium; Baden-Baden, F.R. Germany (13 Sep 1975).

Studies of oxo cations of Np(V) and Np(VI) were made on single crystals using X-ray diffraction and spectroscopic methods. Quantitative measurements of the geometry of the triatomic ion and its uranyl(VI) analog made it possible to assess the effects on bond lengths of the nature of equatorial secondary bonds, the change in valence from V to VI, and the actinide contraction. Absorption spectra showed marked changes in the solid state compared to the same ion in solution, especially anisotropy with crystal orientation (dichroism). The compounds analyzed were $Na_4NpO_2(O_2)_3.9HO$, $Na_4UO_2(O_2)_3.9H_2O$, $K_4NpO_2(CO_3)_3$, and $BaNpO_2(H_3C_2O_3).2H_2O$. All actinyl ions were found to be linear. The largest difference in M=O bond lengths is between 1.776 in the compound having the relatively weak secondary linkage to carbonate, and 1.843 A in which the peroxide forms much stronger covalent bonds. Between compounds identical except for change of U to Np the M=O bond length contracts by only about 0.01 A. However an elongation of about 0.11A is observed when neptunium(VI) is reduced to neptunium(V) without change in the equatorial ligand. (auth)

00591 (CONF-750915—2) **Search for plutonium fluorescence.** Lyster, M.A.; Fellows, R.L.; Young, J.P. (Oak Ridge National Lab., Tenn. (USA)). 1975. 5p. Dep. NTIS $4.00.

From 5. international conference on plutonium and other actinides; Baden-Baden, F.R. Germany (10 Sep 1975).

The possible fluorescence of aqueous Pu in its various oxidation states at room temperature was investigated, over the wavelength range of 300 to 800 nm. For each oxidation state, absorption spectral measurements were made of the experimental solutions, both before and after fluorometric study, to confirm that the desired oxidation state of Pu was studied. No emissions were observed for aqueous solutions of plutonium in any of its oxidation states of (III), (IV), (V), (VI) or (VII). A reaction of thenoyltrifluoroacetone (TTA) with Pu(VI) was found to yield a fluorescent, organic product which might serve as a basis for a fluorometric determination of Pu(VI). In a slightly basic solution, pH 7 to 8, Pu(VI) will oxidize TTA within a matter of seconds to yield a product that exhibits an emission peak at 550 nm with a shoulder at 500 nm. It was demonstrated that Pu(VI) is reduced to Pu(IV) in the reaction with TTA. The method is suited to the fluorometric determination of Pu(VI) even in the presence of Pu(IV), and with the incorporation of photon counting techniques, the determination could be quite sensitive. (auth)

00592 (LA-UR—75-1364) **Bond lengths and bond strengths in compounds of the 5f elements.** Zachariasen, W.H. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 6p. (CONF-750913—6). Dep. NTIS $4.00.

From 4. international transplutonium elements symposium; Baden-Baden, F.R. Germany (13 Sep 1975).

The variation of bond length (D) with bond strength (S) in normal valence compounds of 3d, 4d, 5d-4f, and 6d-5f elements can be represented approximately as D(S) = D(0.5) F(S), where D(0.5) is a characteristic constant for a given bond and F(S) an empirical function which is the same for all bonds. A bond strength S/sub ij/ = S/sub ji/ is assigned to the bond between atoms i and j such that Σ/sub j/ S/sub ij/ = v/sub i/ and Σ/sub i/ S/sub ij/ = v/sub j/, where v/sub i/ and v/sub j/ are the normal valences of the two atoms. The function F(S) decreases monotonically with increasing S, and is normalized to unity at S = 0.5, so that the constant D(0.5) has the physical meaning of being the bond length adjusted to S = 0.5. The method described above was used to interpret and systematize the experimental results on bond lengths in oxides, halides, and oxyhalides of the 5f elements. (auth)

00593 (LA-UR—75-1402) **Hydration energies and specific influence of oxo complexes and high coordination numbers on the predicted chemistry of superheavy elements.** Jorgensen, C.K.; Penneman, R.A. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 6p. (CONF-750913—7). Dep. NTIS $4.00.

From 4. international transplutonium elements symposium; Baden-Baden, F.R. Germany (13 Sep 1975).

On the basis of an analysis of the known ionization energies of gaseous ions and aqua ions of the 3d, 4f, and 6d transition groups and the radius effects, the chemistry of the superheavy elements is predicted. The formation of aqua ion and oxo complexes in the elements with Z below 121 is considered. It is probable that the series from 123 to 140 constitute a close analogy to the lanthanides with Th-like chemistry. Above Z = 140 the elements will probably displace a transition group behavior. A brief comment is made on the analytical aspects to be expected. (JSR)

00594 (MLM—2254(OP)) **Model for liquid uranium and plutonium with implications on the adjacent solid phases.** Wittenberg, L.J. (Mound Lab., Miamisburg, Ohio (USA)). 1975. Contract AT-33-1-GEN-53. 13p. (CONF-750915—9). Dep. NTIS $4.00.

From 5. international conference on plutonium and other actinides; Baden-Baden, F.R. Germany (10 Sep 1975).

The hard-sphere model for liquid metals, which is used to analyze the physical properties of liquid uranium and plutonium, predicted successfully only the compressibility of liquid plutonium while it underestimated the measured viscosity and surface tension values. Based upon a correlation with the rare earth elements, the heat capacities of liquid uranium and plutonium were smaller and their heats of vaporization were larger than predicted. All these deviations suggest additional attractive energy in these two liquids. Diffusion and positron annihilation experiments suggest the appearance of liquid-like clusters in the bcc phases that exist in equilibrium with these liquids. The elastic modulus of /sub epsilon/Pu without these clusters was calculated to be approximately five times larger than the measured modulus. (auth)

00595 (ORNL—5025, pp 79) **Chemistry of nobelium, element 102.** Dittner, P.F.; Keller, O.L.; McDowell, W.J.; Meyer, R.E.; Silva, R.J.; Tarrant, J.R. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

00596 (ORNL—5057) **Indexed bibliography on tritium: its sources and projections, behavior, measurement and monitoring**

techniques, health physics aspects, and waste management. Dixon, M.N.; Holoway, C.F.; Houser, B.L.; Jacobs, D.G. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. vp. Dep. NTIS $13.60.

References are presented to the world literature on sources of tritium in the environment, the migration of tritium in the environment and uptake by biological materials, monitoring methods, health aspects, and radioactive waste management. Subject, author, and permuted title indexes are included. (CH)

00597 (TID—26506) **Kinetics of the oxidation-reduction reactions of uranium, neptunium, plutonium, and americium in aqueous solutions.** Newton, T.W. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. 140p. Dep. NTIS $5.45.

This is a review with about 250 references. Data for 240 reactions are cataloged and quantitative activation parameters are tabulated for 79 of these. Some empirical correlations are given. Twelve typical reactions are discussed in detail, along with the effects of self-irradiation and ionic strength. (auth)

RADIOISOTOPE PRODUCTION

00598 (ANL—8153, pp 60-61) **Nuclear medical isotope research.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

^{81}Rb is produced in high specific activity and yield by the reaction ^{79}Br(α,2n)^{81}Rb. The ^{81}Rb is purified and absorbed on an ion-exchange column in a minigenerator, which allows the elution, at a rapid rate, of the /SUP 81m/Kr daughter in a biologically compatible, sterile solution. Applications of /sup 81m/Kr are described. Chemical binding in tumor cells is being studied and the use of /sup 134m/Cs for myocardial scanning is being evaluated. (MCG)

00599 (CONF-750913—1) **Preparation and study of elemental californium-249.** Noe, M.; Peterson, J.R. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry; Oak Ridge National Lab., Tenn. (USA)). 1975. 8p. Dep. NTIS $4.00.

From 4. international transplutonium elements symposium; Baden-Baden, F.R. Germany (13 Sep 1975).

Bulk samples of ^{249}Cf metal were prepared on the 10 μg scale via the Li metal vapor reduction of $^{249}CfF_3$. Above about 725°C elemental Cf exhibits a face-centered cubic (fcc) structure with an average, room-temperature lattice parameter of 5.75(1)A. Between about 600°C and 725°C, the stable form of Cf metal is another fcc structure with an average, room-temperature lattice parameter of 4.94(1)A. Below 600°C metallic Cf exhibits a double hexagonal closest packed (dhcp) structure with average, room temperature lattice parameters of a_0 = 3.39(1)A and c_0 = 11.01(5)A. By comparison of the metallic radii calculated for these three forms with those of the receding transuranium elements, it is suggested that the two, lower temperature modifications represent Cf with a metallic valence of three, while the highest temperature form represents a metallic valence of two. Although the data reported here are from the most complete study to date of elemental Cf, the limitations accompanying such microscale research are duly noted. (auth)

00600 (ORNL—5025, pp 230) **^{237}Pu production.** Gross, E.E.; Ludemann, C.A.; Marshall, M.B.; Hahn, R.L.; Ottinger, C.L. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

By the use of a highly enriched ^{235}U metal target with a thickness of 10 MeV and 30-MeV α particles at a beam current of approximately 20 μamp, a substantial quantity of ^{237}Pu was produced by the ^{235}U(α,2n)^{237}U reaction. Heat transfer and containment problems were solved by hot pressing the U between two layers of Cu and wate cooling the sandwich during the 40-hr bombardment. Ion exchange and solvent extraction techniques were used to separate the ^{237}Pu. (JSR)

ENGINEERING

FACILITIES AND EQUIPMENT

00601 (CENC—1239) **Test report on experimental stress analysis of a 24-inch diameter tee (ORNL T-16).** Henley, D.R. (Combustion Engineering, Inc., Chattanooga, Tenn. (USA). Nuclear Components Dept.). Jun 1975. Subcontract 3310. 145p. (ORNL-SUB—3310). Dep. NTIS $10.25.

For Oak Ridge National Lab., TN.

The experimental stress analysis and low cycle fatigue test of one 24" x 24" by 24" schedule 10 stainless steel, ANSI B16.9 tee performed by Combustion Engineering, Inc. are described. The tee was instrumented with 230 rectangular strain gage rosettes. Elastic data was obtained for 12 loading conditions consisting of internal pressure and orthogonal pure moments and orthogonal direct forces applied individually to the free branch and run ends of the tee. One of the run ends of the tee was "built in" throughout the test. All loads were applied through pipe extensions welded to the tee. The tee was fatigue tested to failure by applying a cyclic in-plane moment to the branch of the tee assembly. A through-the-wall fatigue crack occurred at 2344 cycles. Significant tests results are summarized and compared with design values tabulated in the ASME Boiler and Pressure Vessel Code, Section III, 1971. (auth)

00602 (ORNL—5044(Vol.2)) **Stress analyses of flat plates with attached nozzles. Vol. 2: Experimental stress analyses of a flat plate with one nozzle attached.** Battiste, R.L.; Peters, W.H.; Ranson, W.F.; Swinson, W.F. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 124p. Dep. NTIS $5.45.

Vol. 1 of this report compares experimental results with theoretical stress distributions for a flat plate with one nozzle configuration and for a flat plate with two closely spaced nozzles attached. This volume contains the complete test results for a flat plate with one nozzle attached that was subjected to 1:1 and 1:2 biaxial planar loadings on the plate, to a thrust loading on the nozzle, and to a moment loading on the nozzle. The plate tested was 36 x 36 x 0.375 in., and the attached nozzle had an outer dia of 2.625 in. and a 0.250-in.-thick wall. The nozzle was located in the center of the plate and was considered to be free of weld distortions and irregularities in the junction area. (auth)

00603 (ORNL-SUB—2203-1) **Experimental stress analysis of the attachment region of hemispherical shells with attached nozzles. Part 5a. Nonradial nozzle at 22-1/2 degrees 2.625 in. O.D.—2.500 in. I.D., zero penetration.** Maxwell, R.L.; Holland, R.W. (Tennessee Univ., Knoxville (USA). Dept. of Mechanical and Aerospace Engineering). Mar 1975. 175p. Dep. NTIS $11.75.

For Oak Ridge National Lab., TN.

A continuing series of investigations has been conducted to determine experimentally the stress patterns for the junction region of spherical shells with radially and non-radially attached nozzles when subjected to internal pressure and various types of loadings on the nozzles. Results of the investigations conducted on a non-radially attached nozzle of 2.625 in.-OD, 2.500 in.-ID and finished flush with the inner surface of the hemisphere are reported. The nozzle is inclined at 22$^1/_2$° from a radial axis. Stress values were determined for the following types of loading: internal pressure applied to the hemisphere and nozzle assembly; an axial load applied collinear with nozzle; and a pure torque applied in the radial plane of the nozzle. (LCL)

00604 (ORNL-SUB—2203-2) **Experimental stress analysis of the attachment region of hemispherical shells with attached nozzles. Part 5b. Nonradial nozzle at 22-1/2 degrees 2.625 in. O.D.—2.500 in. I.D., zero penetration.** Maxwell, R.L.; Holland, R.W. (Tennessee Univ., Knoxville (USA). Dept. of Mechanical and Aerospace Engineering). Jun 1975. 179p. Dep. NTIS $12.00.

For Oak Ridge National Lab., TN.

A continuing series of investigations has been conducted to determine experimentally the stress patterns for the junction region of spherical shells with radially and non-radially attached nozzles when subjected to internal pressure and various types of loadings on the nozzles. Results of the investigations conducted on a non-radially attached nozzle of 2.625 in.-OD, 2.500 in.-ID and finished flush with the inner surface of the hemisphere are reported. The nozzle is inclined at 22$^1/_2$° from a radial axis. Stress values were determined for the loading of a pure bending moment or axial couple applied in various axial planes of the nozzle. (LCL)

00605 (ORNL-SUB—2203-3) **Experimental stress analysis of the attachment region of hemispherical shells with attached nozzles. Part 5c. Nonradial nozzle at 22-1/2 degrees 2.625 in. O.D.—2.5000 in. I.D., zero penetration.** Maxwell, R.L.; Holland, R.W. (Tennessee Univ., Knoxville (USA). Dept. of Mechanical and Aerospace Engineering). Jun 1975. 195p. Dep. NTIS $12.75.

For Oak Ridge National Lab., TN.

A continuing series of investigations has been conducted to determine experimentally the stress patterns for the junction region of spherical shells with radially and non-radially attached nozzles when subjected to internal pressure and various types of loadings on the nozzles. Results of the investigations conducted on a non-radially attached nozzle of 2.625 in.-OD, 2.500 in. ID, and finished flush with the inner surface of the hemisphere are reported. The nozzle was inclined at 22$^1/_2$° from a radial axis. Stress values for

the following types of loadings are tabulated: internal pressure applied to the hemisphere and nozzle assembly; an axial load applied collinear with nozzle; a pure torque applied in the radial plane of the nozzle; and a pure bending moment or axial couple applied in various axial planes of the nozzle. Various stress vs. profile curves are presented. These curves present the tabulated stress data in graphical format. (LCL)

00606 (Y—1972) **Analysis of stresses in filament-wound spherical pressure vessels produced by the delta-axisymmetric pattern.** Knight, C.E. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 8 Aug 1975. Contract W-7405-eng-26. 82p. Dep. NTIS $4.00.

Spherical pressure vessels may be produced by filament winding the composite material with a delta-axisymmetric pattern. This particular pattern yields a composite with high fiber density and efficient and reproducible structures. The pattern is readily defined mathematically and, thus, eases the analysis problem. (auth)

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

00607 (LA-UR—75-1099) **Evaluation of pre-impregnated resin-glass systems for insulating superconducting magnets.** Schermer, R.I. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 14p. (CONF-750716—6). Dep. NTIS $4.00.

From International cryogenic materials conference; Kingston, Ontario, Canada (22 Jul 1975).

Superconducting magnets using adiabatically stable conductors may be fabricated using a resin-glass insulating system applied to the conductor before winding and cured after winding. Preliminary screening for strength and convenience of use has been performed on seven possible candidate systems. Results are presented for butt-tensile tests at 300°K and 77°K and a description is given of the physical handling characteristics for each system. (auth)

PROTECTIVE STRUCTURES AND EQUIPMENT

00608 (ANL/HFEF—006) **Plutonium contamination monitoring in the HFEF hot cells during sectioning of Mark-IIA sodium loops.** Cook, J.H.; Villarreal, R.; Holson, C.E.; Kerr, J.F. (Argonne National Lab., Idaho Falls, Idaho (USA)). May 1975. Contract W-31-109-Eng-38. 48p. Dep. NTIS $5.50.

An extensive program for monitoring alpha contamination was conducted in-cell and out-of-cell in HFEF/S to establish the contamination spread from sectioning sodium loops that contained failed mixed-oxide fuel elements. The monitoring program was maintained during the sectioning of six RAS-TREAT Mark-IIA loops in the argon cell. The monitoring program provided conclusive evidence that no contamination spread resulted from sectioning the loops. (auth)

00609 (CONF-750822—2) **Decommissioning of the Fission Product Development Laboratory at Holifield National Laboratory.** Schaich, R.W. (Oak Ridge National Lab., Tenn. (USA)). 1975. 23p. Dep. NTIS $4.25.

From 14. international conference on low temperature physics; Otaniemi, Finland (14 Aug 1975).

The decontamination of the Fission Product Development Laboratory at Holifield National Laboratory was initiated in FY 1975 after 17 years of processing fission product waste streams to produce commercial quantities of ^{90}Sr, ^{137}Cs, ^{144}Ce, and ^{147}Pm. The objective of the decommissioning program is the removal of all radiation and contamination areas in the facility to a level which will be compatible with the environment in the foreseeable future. The initial phase of the decommissioning of the Fission Product Development Laboratory has been accomplished by reducing the radioactive content in the facility by a factor of 10^3. The intermediate phase of reducing the curie quantities of fission products by an additional factor of 10^3 will require considerable personnel exposure and direct contact type of operations. The final phase of shielding and sealing to acceptable levels of radiation and contamination can be accomplished with a minimum of personnel exposure. A substantial monetary investment will be required to allow a complete shutdown of the facility. (TFD)

HANDLING EQUIPMENT AND PROCEDURES

00610 (CONF-750930—1) **Proposed master-slave and automated remote handling system for high-temperature gas-cooled reactor fuel refabrication.** Grundmann, J.G. (Oak Ridge National Lab., Tenn. (USA)). 1974. 18p. Dep. NTIS $4.00.

From 5. international symposium on industrial robots; Chicago, Illinois, USA (22 Sep 1975).

The Oak Ridge National Laboratory's Thorium-Uranium Recycle Facility (TURF) will be used to develop High-Temperature Gas-Cooled Reactor (HTGR) fuel recycle technology which can be applied to future HTGR commercial fuel recycling plants. To achieve recycle capabilities it is necessary to develop an effective material handling system to remotely transport equipment and materials and to perform maintenance tasks within a hot cell facility. The TURF facility includes hot cells which contain remote material handling equipment. To extend the capabilities of this equipment, the development of a master-slave manipulator and a 3D-TV system is necessary. Additional work entails the development of computer controls to provide: automatic execution of tasks, automatic traverse of material handling equipment, automatic 3D-TV camera sighting, and computer monitoring of in-cell equipment positions to prevent accidental collisions. A prototype system which will be used in the development of the above capabilities is presented. (auth)

SHIPPING CONTAINERS

00611 (DP-MS—74-58) **Dynamics of impact in drop tests of packaging.** Langhaar, J.W. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1975. 48p. (CONF-750411—7). Dep. NTIS $5.50.

From European nuclear conference; Paris, France (21 Apr 1975).

IAEA regulations require that packages containing more than a very small amount of radioactive or fissile material must withstand a drop from 9 m onto a target which is a flat, horizontal surface without escape of radioactive material, increase of external radiation level, and possible criticality. The troublesome mechanical aspects of demonstrating compliance with the drop test regulation are examined, and recommendations are made for further guidance from regulatory and standards organizations on the manner in which these aspects should be taken into account. (LCL)

00612 (Y-DD—164) **Safety analysis report for packaging (Oak Ridge Y-12 Plant Model 44 unirradiated fuel element package).** Dyer, H.R. (Oak Ridge Y-12 Plant, Tenn. (USA)). 29 Aug 1975. Contract W-7405-eng-26. 24p. Dep. NTIS $4.00.

An evaluation was made of the Y-12 Model 44 unirradiated Rover reactor fuel element shipping container to demonstrate its compliance with federal regulations governing the interstate transportation of fissile materials. Destructive testing and engineering evaluations were made to demonstrate the structural integrity and thermal resistance of the package in meeting the physical testing requirements described in the ERDA regulations. (a) Reactor transport theory computer codes were used to analyze the criticality safety of the package. Results of this evaluation show that the package complies with all applicable regulations for Fissile Class I shipments of not more than 44 unirradiated Rover reactor fuel elements, with each package containing not more than 16 kg of uranium, enriched to 93 wt percent in the ^{235}U isotope. (auth)

LASERS

00613 (LA-UR—75-839) **Laser application of heat pipe technology in energy related programs.** Carbone, R.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 16p. (CONF-750812—11). Dep. NTIS $4.00.

From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).

The design and operating parameters for a heat pipe laser utilizing metal vapors are proposed. The laser would be applied to laser induced fusion, laser induced chemistry, laser isotope separation and power transport using optical beams. (TFD)

00614 (SAND—75-5237) **Electron-beam-excited gas laser research.** Johnson, A.W.; Gerardo, J.B.; Patterson, E.L.; Gerber, R.A.; Rice, J.K.; Bingham, F.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 23p. (CONF-750660—1). Dep. NTIS $4.25.

From 2. all-union symposium on gas laser physics; Novosibirsk, USSR (Jun 1975).

Net energy gain in laser fusion places requirements on the laser that are not realized by any existing laser. Utilization of relativistic electron beams (REB's), a relatively new source for the excitation of gas laser media, may lead to new lasers that could satisfy these requirements. Already REB's have been utilized to excite gas laser media and produce gas lasers that have not been produced as successfully any other way. Electron-beam-excitation has produced electronic-transition dimer lasers that have not yet been produced by any other excitation scheme (for example, Xe$_2$/sup *(1)/, Kr:O(2'S)/sup 2/, KrF/sup *(3)/). In addition, REB's

have initiated chemical reactions to produce HF laser radiation with unique and promising results. Relativistic-electron-beam gas-laser research is continuing to lead to new lasers with unique properties. Results of work carried out at Sandia Laboratories in this pioneering effort of electron-beam-excited-gas lasers are reviewed. (TFD)

00615 (UCID—16861) **Stress in high energy flashlamp envelopes.** Tuft, D.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Mar 1974. Contract W-7405-Eng-48. 22p. Dep. NTIS $4.25.

Failure of high energy flashtubes which are used to optically pump solid state lasers has become a critical factor in the operation of large laser systems which require large numbers of flashlamps for operation. Failures in flashlamps are generally catastrophic in nature and can cause damage to other critical laser components within the laser head as well as render the laser module inoperable. Attempts have been made to increase the reliability and lifetime of flashlamps by reducing the operating energy at the expense of overall laser efficiency. The extent that thermal stress contributes to failure in flashlamps is discussed. Since experimental measurements of temperature or stress fields in a flashlamp envelope during the period of interest (the flashlamp pulse) are not practical, or at best would be extremely difficult, the approach will be from a purely analytical standpoint. Also as a result of the extremely complex nature of the physical mechanisms involved, this note will be an attempt only to bracket the possible stress and temperature fields which occur in a highly idealized model. (auth)

00616 (UCRL—75490) **Review of bound free laser systems.** Rhodes, C.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Feb 1974. 6p. (CONF-740404—3). Dep. NTIS $4.00.

From Region 6 conference; Albuquerque, New Mexico, USA (24 Apr 1974).

The properties of the stimulated emission arising from high pressure rare gases excited by relativistic electron beams are summarized. The three materials reported to date are argon, krypton, and xenon which produce intense stimulated spectra at approximately 1265 A, approximately 1475 A, and approximately 1720 A, respectively. (auth)

00617 **X-ray lasers.** Chapline, G.; Wood, L. (Univ. of California, Livermore). *Phys. Today;* **28**: No. 6, 40-45; 48(Jun 1975).

Possible approaches to the development of x-ray lasers are reviewed. The impact of x-ray lasers on research in chemistry, biology, and crystallography are discussed. (TFD)

HEAT TRANSFER AND FLUID FLOW

00618 (SAND—75-8610) **Natural convection of a heat-generating fluid within closed vertical cylinders and spheres.** Kee, R.J.; Landram, C.S.; Miles, J.C. (Sandia Labs., Livermore, Calif. (USA)). Apr 1975. Contract AT(29-1)-789. 17p. (CONF-750804—8). Dep. NTIS $4.00.

From Conference on heat transfer; San Francisco, California, USA (11 Aug 1975).

Steady natural convective flow fields were numerically and experimentally characterized for 0.7 Prandtl number fluids having constant, uniformly distributed, internal heat sources. The bounding isothermal walls containing the fluid were considered to be either a sphere or a cylinder of finite height. An instrumented cylinder containing radioactive tritium gas was used to demonstrate experimental and analytical agreement for local temperatures over a range of Grashof numbers. For the spherical geometry, a generalized correlation was obtained for the surface-averaged Nusselt number as a function of a modified Grashof number. (auth)

00619 **Axial propagation of free surface boiling into superheated liquids in vertical tubes.** Grolmes, M.A.; Fauske, H.K. (Argonne National Lab., IL). pp 30-34 of **Heat transfer, 1974. Vol. 4.** Washington, DC; Scripta Book Co. (1974).

From 5. international heat transfer conference; Tokyo, Japan (3 Sep 1974).

See CONF-740925—P4.

A unique free surface boiling phenomenon has been observed as a result of rapid depressurization of an initially saturated or slightly subcooled stagnant liquid column in the absence of wall and bulk nucleation sites. Closeup high-speed photographs of water, refrigerant-11, and methyl alcohol in tubes from 0.2 to 15 in. dia reveal that the initiation of violent free surface flashing (vapor plus entrained liquid) follows from the development of Marangoni-type surface waves. The rate of propagation of the flashing surface shows evidence of choked flow limitations and proceeds at a rate which is several orders of magnitude greater than surface evaporation (vapor only) alone. The onset of free surface flashing was found to be dependent upon both the degree of initial liquid superheat and the tube diameter. (auth)

00620 **Incipient superheat in a convective sodium system.** Henry, R.E.; Singer, R.M.; Quinn, D.J.; Jeans, W.C. (Argonne National Lab., IL). pp 305-309 of **Heat transfer, 1974. Vol. 4.** Washington, DC; Scripta Book Co. (1974).

From 5. international heat transfer conference; Tokyo, Japan (3 Sep 1974).

See CONF-740925—P4.

Experimental measurements are reported for incipient boiling superheats in a convective sodium system. The results show that definitive evaluation of the incipient wall superheat requires a knowledge of the location of inception and detection of any entrained noncondensable gas bubbles. It is shown that, when history and gas solubility effects are properly accounted for, a reentrant cavity model is representative of the data. (auth)

00621 **Transient two-phase flow.** Hsu, Y.Y. (Atomic Energy Commission, Washington, DC). pp 169-176 of **Heat transfer, 1974. Vol. 7.** Washington, DC; Scripta Book Co. (1974).

From 5. international heat transfer conference; Tokyo, Japan (3 Sep 1974).

See CONF-740925—P7.

The following papers related to two-phase flow are summarized: current assumptions made in two-phase flow modeling; two-phase unsteady blowdown from pipes, flow pattern in Laval nozzle and two-phase flow dynamics; dependence of radial heat and momentum diffusion; transient behavior of the liquid film around the expanding gas slug in a vertical tube; flooding phenomena in BWR fuel bundles; and transient effects in bubble two-phase flow. (LCL)

MATERIALS TESTING

00622 (BDX—613-1353) **Measuring penetration depth of electron beam welds. Final report.** Hill, J.W.; Collins, M.C.; Mentesana, C.P.; Watterson, C.E. (Bendix Corp., Kansas City, Mo. (USA)). Jul 1975. Contract AT(29-1)-613. 17p. Dep. NTIS $4.00.

The feasibility of evaluating electron beam welds using state-of-the-art techniques in the fields of holographic interferometry, micro-resistance measurements, and heat transfer was studied. The holographic study was aimed at evaluating weld defects by monitoring variations in weld strength under mechanical stress. The study, along with successful work at another facility, proved the feasibility of this approach for evaluating welds, but it did not assign any limitations to the technique. The micro-resistance study was aimed at evaluating weld defects by measuring the electrical resistance across the weld junction as a function of distance along the circumference. Experimentation showed this method, although sensitive, is limited by the same factors affecting other conventional nondestructive tests. Nevertheless, it was successful at distinguishing between various depths of penetration. It was also shown to be a sensitive thickness gage for thin-walled parts. The infrared study was aimed at evaluating weld defects by monitoring heat transfer through the weld under transient thermal conditions. Experimentation showed that this theoretically sound technique is not workable with the infrared equipment currently available at Bendix Kansas City. (auth)

ELECTRONIC CIRCUITS AND DEVICES

00623 (SAND—75-0159) **Effect of system parameters on substrate bias during D.C. and R.F. sputter deposition.** Kominiak, G.J.; Bland, R.D. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jul 1975. Contract AT(29-1)-789. 17p. Dep. NTIS $4.00.

When an electrically isolated substrate holder is immersed in a gas discharge, as in sputter deposition, the holder and substrates are exposed to bombardment by energetic secondary electrons which may result in large substrate bias voltages. The induced substrate potential is affected by many system parameters. In this investigation, we have measured the variation of bias at an electrically floating substrate as a function of gas pressure and target to substrate separation for both d.c. and r.f. sputtering discharges. In the case of d.c. sputtering the voltages in question may attain negative potentials of up to 1 kV. Operating under these conditions will cause severe heating of the substrates and the growing deposits. R.F. sputtering discharges on the other hand, induce relatively small negative (less than -100 V) and positive voltages at the substrate. These small positive biases have been shown

to markedly affect the properties of r.f. sputtered metal films. In the case of r.f. sputter deposited chromium, electrically floating the substrates resulted in deposits which were only approximately 70 percent dense. (7 figs, 19 refs) (auth)

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

00624 (ANL—8153, pp 90-95) **Accelerator development.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Because the use of accelerated heavy ions would provide many opportunities for new and important studies in nuclear physics and nuclear chemistry, as well as other disciplines, both the Chemistry and Physics Divisions are supporting the development of a heavy-ion accelerator. The design of greatest current interest includes a tandem accelerator with a terminal voltage of approximately 25 MV injecting into a linear accelerator with rf superconducting resonators. This combined accelerator facility would be capable of accelerating ions of masses ranging over the entire periodic table to an energy corresponding to approximately 10 MeV/nucleon. This approach, as compared to other concepts, has the advantages of lower construction costs, lower operating power, 100 percent duty factor, and high beam quality (good energy resolution, good timing resolution, small beam size, and small beam divergence). The included sections describe the concept of the proposed heavy-ion accelerator, and the development program aiming at: (1) investigation of the individual questions concerning the superconducting accelerating resonators; (2) construction and testing of prototype accelerator systems; and (3) search for economical solutions to engineering problems. (auth)

00625 (CONF-741001—, pp 149-156) **Computer utilization for design and operation of the SuperHILAC.** Selph, F.B.; Spence, D.A. (Univ. of California, Berkeley). 1974.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Cube symposium, Lawrence Livermore Laboratory, October 23—25, 1974. Symposium proceedings.

The in-house constructed computer codes at the SuperHILAC can be divided into three main categories: (1) accelerator and component design; (2) control and operation; and (3) performance and diagnostics. The first category includes design programs of rf cavities, magnets, and beam optics. The second group contains programs for administration and logbook entries, machine parameter specifications, and openloop parameter control. Programs in the third category are those which directly or indirectly test the mechanical design and geometry of the machine, such as magnet testing, drift-tube-alignment, beam behavior and diagnostics. The present conversion of the SuperHILAC to computer control and a dual-ion time-sharing mode of operation is outlined in context with the complexities of operating this multi-ion, variable energy accelerator. Routines are discussed from the user's standpoint, covering such topics as on-line/off-line implementation, expected gain, actual results, and differences in characteristics which determine the method of computation. (auth)

00626 (CONF-741001—, pp 208-215) **Drift tube alignment and beam emittance codes in use at the SuperHILAC.** Spence, D.A. (Univ. of California, Berkeley). 1974.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Cube symposium, Lawrence Livermore Laboratory, October 23—25, 1974. Symposium proceedings.

Two Fortran-IV codes in use at the SuperHILAC are of significant value in optimizing the geometry of the accelerator and in evaluating the performance of the heavy ion beams. The first routine described is used to determine the existing root mean square deviation of the 210 internal drift tube quadrupoles fitted to a straight line or to a second-order quadratic. It then predicts the minimum number of drift tubes, and their identities, to be moved in order to attain a user-elected margin of error fit. Brief mention is made of the pulsed-wire alignment technique for the quadrupole positioning. The second program described is part of a data system which utilizes a PDP-8/I as a control device for the manipulation of beam-scanning hardware and a CDC-6600 in an off-line interactive mode which gives the user maximum versatility in treating the raw data and displaying the results of calculations. The code portrays the transverse beam emittance figures and their transmission through the accelerator and transport lines. Also discussed are future plans which include on-line data reduction and CRT display by the PDP-8/I to enable the operators to optimize the tuning of the HILAC. (auth)

00627 (LBL—3693) **Status and outlook for heavy-ion accelerator systems.** Grunder, H.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1975. Contract W-7405-eng-48. 5p. (CONF-750335—72). Dep. NTIS $4.00.

From Particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

There are five major heavy-ion centers constructed or funded worldwide; two additional centers are on the verge of being funded. Additionally, there are numerous smaller installations producing excellent science. Most installations aim at 10 MeV/u for the higher mass particles, and as high as possible for lighter ions. Berkeley and Dubna have reached or plan to reach relativistic energies for heavy ions. Studies and proposals for additional relativistic heavy-ion facilities are pursued at least in five places. There is an obvious energy gap in proposed facilities, namely, 30 to 150 MeV/u for high-mass particles. Searches should be made for inexpensive magnets for high Bo in circular machines, or for very high, inexpensive electric gradients in linacs. This picture could be dramatically changed with a real breakthrough in ion source development. (auth)

00628 (TRI-PP—75-1) **Production of simultaneous, variable energy beams from the TRIUMF cyclotron.** Richardson, J.R.; Blackmore, E.W.; Dutto, G.; Kost, C.J.; Mackenzie, G.H.; Craddock, M.K. (British Columbia Univ., Vancouver (Canada). Dept. of Physics). Mar 1975. 6p. (CONF-750335—66). Dep. NTIS $4.00.

From Particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

An extracted beam at the design energy of 500 MeV was obtained at TRIUMF in December 1974. Later, beams of varying energies between 180 and 520 MeV were extracted own beam line 4, and further work resulted in the simultaneous extraction of a 506 MeV beam down beam line 1, while variable energy beams were brought down line 4. In order to reduce initial activation of cyclotron components, time average beams were restricted to 100 nA, but 12 μA in a pulsed beam was very easily obtained at 500 MeV. Without much optimization of the injection conditions and without use of the harmonic trim coils, an energy spread (full width) of 2.5 to 3.0 MeV was observed. Ordinarily, the macro-duty factor was 100 percent and the micro duty factor corresponds to a 5 ns pulse every 44 ns. The transmission to 500 MeV is consistent with the expected loss due to gas stripping. (auth)

AUXILIARIES AND COMPONENTS

00629 (LA—5954) **100-MHz power amplifier design and control for a heavy-ion accelerator.** Lunsford, J.S.; Shipley, J.P.; Sutton, J. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. 11p. Dep. NTIS $4.00.

Design details are given for a typical power amplifier and its control systems to be used for the approximately 80 spiral resonating cavities of the proposed heavy-ion accelerator at Los Alamos Scientific Laboratory. Operational procedures and some experimental results are also described. Plate circuit design is important for maximum efficiency and stability. The original movable-short, fixed-tap design was not optimal, and several improvements are described. Perturbation controllers are required for the cavity rf phase, amplitude, and resonant frequency. The amplitude control is done by varying the power amplifier screen-grid voltage. Typical power amplifier output is 20 kW at 33 percent plate efficiency and 19-dB gain. (auth)

00630 (LBL—3364) **Multi-wire chamber system for heavy ion beam monitoring at the Bevalac.** Cuperus, J.; Morgado, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1975. Contract W-7405-eng-48. 6p. (CONF-750335—26). Dep. NTIS $4.00.

From Particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Horizontal and vertical integrated beam-current profiles are generated by a system of multi-wire chambers (32 wires/profile) operating in either the ionization or proportional mode. Sixteen distinct displays (1024 words) are digitally stored and any four may be simultaneously displayed. A new display can be generated at 64 ms intervals. A central control unit selects the mode of operation, the amount of delay after an appropriate trigger, the chamber integration time, and the particular chambers to be displayed. Operating in the proportional mode, the system can detect relativistic heavy-ion beam intensities as low as 10^4 charges cm^{-2} sec^{-1}. (auth)

00631 (ORNL—5025, pp 79-81) **Development of a reliable gas-jet transport system for use at the ORIC.** Schmidt-Ott, W.D.; Toth, K.S. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The helium gas-jet technique has been used extensively in radioactive decay work and has proven to be an extremely useful tool, especially in its application to heavy ion induced reactions, where large amounts of linear momentum are transferred to the product nuclei. Tests and development of the system are briefly described and applications to nuclear spectroscopy are discussed. It is concluded that mating the system with a mass separator should increase its value for the study of nuclei far from stability. (2 figures) (SDF)

INJECTION AND EXTRACTION SYSTEMS

00632 (LBL—3376) **Design of the ESCAR injection beam line.** Tanabe, J.; Staples, J.; Yourd, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 12 Mar 1975. Contract W-7405-eng-48. 4p. (CONF-750335—71). Dep. NTIS $4.00.

From Particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

The design features of the elements of the ESCAR (Experimental Superconducting Accelerator Ring) injection beam line are described. The junction of the proton transport system with the ESCAR injection straight section requires the design of mechanical elements compatible with the 10^{-11} torr vacuum requirements of the main ring. These elements include a novel septum magnet whose salient design features include a current-carrying septum of tapered thicknesses to reduce the overall power requirements and total enclosure of the magnet coil in a metal can for vacuum compatibility. Other elements are a wire electro-static septum and several fast-rise "bump magnets". A transition cryopump is designed to separate the main ring vacuum from the relatively poor 10^{-6} torr vacuum of the conventional beam transport line. A brief description of the conventional beam transport line from the 50 MeV proton linac, recently installed for Bevatron injection,is also included. (auth)

EXPERIMENTAL FACILITIES AND EQUIPMENT

00633 (ANL/HEP-CP—75-30) **Antiproton experiment facilities at Argonne.** Fields, T. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 6p. (CONF-750547—4). Dep. NTIS $4.00.

From 4. international symposium on nucleon-antinucleon interations; Syracuse, New York, USA (2 May 1975).

A brief summary of the status of antiproton beams and related facilities at the Argonne Zero Gradient Synchrotron is given, including beams for counter experiments and beams for the 12-foot bubble chamber. A track sensitive target (TST) installation for the bubble chamber is described, and a list of presently approved antiproton bubble chamber experiments is given. (PMA)

00634 **Dynamic polarization of nuclei.** Jeffries, C.D. (Univ. of California, Berkeley). pp 217-262 of **Electron paramagnetic resonance.** Geschwind, S. (ed.). New York; Plenum Publishing Corp. (1972).

Dynamic nuclear polarization is a general method of enhancing by several orders the polarization of a nuclear spin system in interaction with an electron spin system by saturation of a suitable resonance of the combined system. By way of introduction, the example of nuclei in dipolar coupling with paramagnetic ions diluted in a solid is presented. This case is important in polarizing targets for nuclear scattering. By the simultaneous action of applied microwave fields and lattice relaxations, one can enhance the nuclear polarization up to the magnitude of the electron polarization itself, which is of order unity at 10 kOe and 1°K. The dipolar case in solids is then considered in quantitative detail, under the following headings: model and rate equations, nuclear relaxation, dynamic polarization (ideal case, unresolved lines), spin temperature theory, phonon bottleneck effects, and applications. Several other cases are discussed more concisely: strong HFS coupling in paramagnetic ions, Overhauser effect, and liquids. The spin refrigerator, a general method of cyclically transferring a large electron spin polarization to nuclear spins without the use of microwaves, is then discussed; after some introductory comments, the properties of Yb:YES, rate equations, and experimental results on Yb:YES are treated. Finally, the subject of optical pumping is examined. (20 figures) (RWR)

STORAGE RINGS

00635 (SLAC-Trans—169) **Use of synchrotron radiation from the VEPP-3 storage ring for x-ray structural studies.** Mokul'skaya, T.D.; Moku'lskii, M.A.;•Nikitin, A.A.; Anashin, V.V.; Kulipanov, G.N.; Lukashov, V.A.; Skrinskii, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Apr 1975. Translation of IAE—2385. 22p. Dep. NTIS $4.25.

Results are reported on the use of electron synchrotron radiation for x-ray diffraction studies of materials. The operating efficiency of all the components and the peculiarities of operating with the SR beam were ascertained. The beam intensity was compared to that obtained with fine-focus x-ray tubes operating at the characteristic radiation of copper. The apparatus for recording the diffraction patterns consisted of a monochromator, an x-ray camera, and a number of auxiliary devices. The diffraction patterns were photographed under different storage-ring operating regimes (electron energy from 1.6 to 2 GeV, current ranging from a fraction of a milliamp to 10 mA). Diffraction patterns for specimens of single crystal materials, metals, and fibrillar polymers were obtained on photographic film. (PMA)

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

00636 (BNL—16922) **Digital environmental monitor.** Chester, J.D.; Chase, R.L.; Wood, S. (Brookhaven National Lab., Upton, N.Y. (USA); Rochester Univ., N.Y. (USA)). 1972. 18p. (CONF-720614—11). Dep. NTIS $4.00.

From 17. annual meeting of the Health Physics Society; Las Vegas, Nevada, USA (12 Jun 1972).

An instrument has been designed to replace the Dynamic Condenser Electrometer to measure the background radiation levels at the boundaries of Brookhaven National Laboratory. The detector is a 2" x 2" tin loaded plastic scintillator, whose energy response is air equivalent, coupled to a bialkali cathode 2" photomultiplier tube operated in the direct current mode. The output of the photomultiplier is digitized by a current to frequency converter, and the resultant pulses fed to a scaler. The system is programmed to calibrate itself once an hour to compensate for changes in photomultiplier tube gain to changes in temperature. During the calibration cycle a number, which is a function of the system's gain, is generated and held in a register, and is then used to weight the data accumulated between calibration cycles. The output data is stored on a six digit non-resetting printing register. The register, which can be programmed to print at any time interval desired, also prints the day of the year, time of day and station number. The instrument, which is calibrated to give 10 counts per μR, has a minimum sensitivity of 1 μR/hr and was designed so that it will not saturate at 10 mR/hr, making it useful in the event of an accidental high level activity release. The digital logic is accomplished by the use of integrated circuits mounted on printed circuit boards housed in NIM modules. The detector is housed in an aluminum weather tight container. Two of the units have been in operation for over a year with no significant maintenance problems. (auth)

00637 (BNWL-SA—5299) **Radon compensation for alpha air monitoring systems.** Fleming, D.M.; Rising, F.L.; Zuerner, L.V. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract AT(45-1)-1830. 18p. (CONF-750707—5). Dep. NTIS $4.00.

From Annual meeting of the Health Physics Society; Buffalo, New York, USA (13 Jul 1975).

Continuous alpha air monitors, employing solid state detectors and single channel analyzers, for the detection of alpha particles of a specific energy have been available commercially for several years. The single channel pulse height analyzers provide good sensitivity to the isotope of interest and reject much of the unwanted activity from other isotopes such as naturally occurring radon and daughters. A small percentage of the radon daughters are degraded in energy by the air between the collecting filter and the diode to the extent that they coincide with energy of the isotope being measured and are counted as unwanted background. When ^{239}Pu is the isotope being measured the activity in the Pu channel resulting from radon is typically 2 percent of the total radon background. The majority of this unwanted background results from the degradation of the 6.0 MeV ^{218}Po (RaA) peak.

This background is sufficient to cause instrument alarms during periods of radon activity. In attempts to reduce the frequency of false alarms, background subtraction circuits have been added as standard equipment to most of the alpha air monitors available on the market for the past several years. A method for calibrating these background subtraction circuits using a radon generator is described. (WHK)

00638 (EGG—1183-2238) **Time response measurements of LASL diagnostic detectors.** Hocker, L.P. (EG and G, Inc., Santa Barbara, Calif. (USA)). Jul 1970. 55p. Dep. NTIS $5.75.

The measurement and data analysis techniques developed under the Los Alamos Scientific Laboratory's detector improvement program were used to characterize the time and frequency response of selected LASL Compton, fluor-photodiode (NPD), and fluor-photomultiplier (NPM) diagnostic detectors. Data acquisition procedures and analysis methods presently in use are summarized, and detector time and frequency data obtained using the EG and G/AEC electron linear accelerator fast pulse (approximately 50 psec FWHM) as the incident radiation driving function are presented. (auth)

00639 (MLM—2248(OP)) **Instrumentation for phoswich detectors.** Tomlinson, F.K. (Mound Lab., Miamisburg, Ohio (USA)). 1975. Contract AT-33-1-GEN-53. 13p. Dep. NTIS $4.00.

The operation and performance of phoswich detectors and their associated readout systems are described. (WHK)

RADIATION DOSEMETERS

00640 (BNL—20100) **Calibration of the experimental BND personnel neutron dosimeter for general use.** Distenfeld, C. (Brookhaven National Lab., Upton, N.Y. (USA)). 1972. 25p. (CONF-750551—1). Dep. NTIS $4.25.

From 5. ERDA workshop on personnel neutron dosimetry; Washington, District of Columbia, USA (6 May 1975).

The experimental Brookhaven neutron dosimeter, BND, is a composite damage track and thermoluminescent detector. Thorium fission is used to respond to greater than 1 MeV and high sensitivity TLD 600 and 700 ribbons respond to softer neutrons. Previous experimental work at the Alternating Gradient Synchrotron, AGS, a 33 GeV proton accelerator, utilized the energy dependence of the ratio of thermoluminescent to Thorium response, softness. Softness variation was related to a correction factor used to adjust a TLD response to properly account for the dose equivalent. Calibration data for the BND for soft reactor spectra are presented. (WHK)

00641 (COO—323-34) **Special problems in nuclear instrumentation. Progress report, 1 June 1974—31 May 1975.** Spokas, J.J. (Illinois Benedictine Coll., Lisle (USA). Physical Sciences Lab.). 1975. Contract E(11-1)-323. 19p. Dep. NTIS $4.00.

The angular dependence of the sensitivity has been studied in 0.5 cc thimble type ionization chambers. A significant variability in neutron sensitivity has been discovered in magnesium chambers. Previous conducting plastic mixtures were reviewed with regard to composition and equivalence. Results are presented and discussed. (WHK)

NUCLEAR SPECTROSCOPIC INSTRUMENTAION

00642 (CONF-750319—3) **Stable isotope ratiometer-multiple ion detector (SIRMID) unit for quantitative and qualitative stable isotope studies by gas chromatography-mass spectrometry.** Klein, P.D.; Haumann, J.R.; Hachey, D.L. (Argonne National Lab., Ill. (USA)). 12 Mar 1975. Contract W-31-109-Eng-38. 24p. Dep. NTIS $4.25.

From 7. annual symposium on advanced analytical concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (13 Mar 1975).

A stable isotope ratiometer-multiple ion detector (SIRMID) unit which can drive existing gas chromatograph-quadrupole or magnetic sector mass spectrometers to monitor up to six ions in turn is described. Each of the three pairs of ions can be selected for quantitation; thus three different or successive components can be analyzed in a single GC run. A background subtraction option permits the ion intensity in the absence of sample to be subtracted automatically during sample measurement. Displays of accumulated counts and isotope ratio are updated twice per second during the measurement and can be printed out at its conclusion. All six ions can be monitored in the analog mode by parallel outputs to a multipen recorder. Experience gained in the construction of this prototype indicates that SIRMID units could be commercially available for $10K, or about $^1/_5$rd to $^1/_8$th of the cost of even an inexpensive computer system. (auth)

00643 (EGG—1183-2239) **Time response, linearity, and gain of 250-micron silicon solid-state detectors.** Pigg, J.L.; John, W.; Janee, H.S.; Hocker, L.P. (EG and G, Inc., Santa Barbara, Calif. (USA)). Jun 1970. Contract AT(29-1)-1183. 105p. Dep. NTIS $8.25.

Experiments are described in which the time response, linearity, and gain were determined for the 250-micron silicon solid-state detectors used in a solid-state magnetic gamma-ray spectrometer. Time-response measurements performed at the EG and G/AEC linear accelerator (linac) determined detector impulse response, step response, frequency-domain amplitude, and phase as a function of frequency. Linearity measurements performed with the linac determined detector current and charge linearity at bias levels up to 500 V. Gain measurements made in the counting mode at the NBS Dynamitron (0.25 to 1.0 MeV) and Van de Graaff (2.0 to 4.0 MeV) accelerators determined gain as a function of incident electron energy. (auth)

00644 (IS—3636) **PEAKFIND: a FORTRAN program for locating and fitting peaks in semiconductor detector spectra.** Schick, W.C. Jr. (Ames Lab., Iowa (USA)). Jun 1975. Contract W-7405-eng-82. 92p. Dep. NTIS $7.75.

A FORTRAN program is described which locates peaks in semiconductor detector spectra and then fits a skewed-Gaussia ine shape to certain of these peaks to determine centroids, areas, and peak shape parameters. The user may adjust the strictness of criteria used in the peak location procedure to permit the identification of virtually anything that might possibly be a peak, or he may specify that only well-defined peaks are to be found. An estimate is made of the centroid, energy, and intensity (corrected for the energy dependence of the detector efficiency) for each peak found. Fitting is then performed only where the estimated peak intensity exceeds a lower limit specified by the user. Alternatively, the user may specify which specific peaks he wishes to have fitted. The nonlinear least-squares fitting method is a modification of the procedure used in the companion program SKEWGAUS. PEAKFIND normally requires the user to supply only four input data cards for the analysis of a whole multichannel analyzer spectrum, and if default options are chosen for most parameters these cards will be largely blank. (auth)

00645 (ORNL—5025, pp 120-122) **Absolute calibration of neutron detectors in the 10- to 30-MeV range.** Fowler, J.L.; Cookson, C.A.; Schwartz, R.B.; Hussain, M.; Uttley, C.A. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

An experiment was conducted to determine the forward scattering of neutrons from protons at energies below 30 MeV. The associated particle method was used to determine the absolute efficiency of the neutron detector. The reaction chamber for absolute calibration is diagrammed. (SDF)

HIGH ENERGY PHYSICS INSTRUMENTATION

00646 (BNL—20226) **4π detector for correlation experiments.** Thorndike, A.M. (Brookhaven National Lab., Upton, N.Y. (USA)). 12 Jun 1975. 12p. Dep. NTIS $4.00.

A conceptual design of a 4π detector for ISA-BELLE involves a counter hodoscope with 302 elements and an array of proportional wire chambers with 8950 wires. Such a detector could be used for correlation experiments and measurements of total cross section, as has been done by the Pisa-Stony Brook group at the ISR. (auth)

RADIOMETRIC INSTRUMENTS

00647 (UCRL—76740) **Automated sample changer for x-ray fluorescence analysis of bio-medical samples.** Camp, D.C.; Voegele, A.L.; Friesen, R.D.; Kaufman, L.; Hruska, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Jul 1975. 15p. Dep. NTIS $4.00.

The basic components and operation of the changer are described. The more important mechanical features are presented. A brief description is given of the basic electronic logic used for control. (TFD)

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

00648 (SAND—75-5607) **Process controls for radiation hardened aluminum gate bulk silicon CMOS.** Gregory, B.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 7p. (CONF-750703—11). Dep. NTIS $4.00.

From IEEE annual conference on nuclear and space radiation effects; Arcata, California, USA (14 Jul 1975).

Optimized dry oxides have recently yielded notable improvements in CMOS radiation-hardness. By following the proper procedures and recipes, it is now possible to produce devices which will function satisfactorily after exposure to a total ionizing dose in excess of 10^6 RADS (Si). This paper is concerned with the controls required on processing parameters once the optimized process is defined. In this process, the pre-irradiation electrical parameters must be closely controlled to insure that devices will function after irradiation. In particular, the specifications on n- and p-channel threshold voltages require tight control of fixed oxide charge, surface-state density, oxide thickness, and substrate and p-well surface concentrations. In order to achieve the above level of radiation hardness, certain processing procedures and parameters must also be closely controlled. Higher levels of cleanliness are required in the hardened process than are commonly required for commercial CMOS since, for hardened dry oxides, no impurity gettering can be employed during or after oxidation. Without such gettering, an unclean oxide is unacceptable due to bias-temperature instability. Correct pre-oxidation cleaning, residual surface damage removal, proper oxidation and annealing temperatures and times, and the correct metal sintering cycle are all important in determining device hardness. In a reproducible, hardened process, each of these processing steps must be closely controlled. (auth)

MISCELLANEOUS INSTRUMENTS

00649 (LBL—3860) **System of coils for increasing the volume of homogeneous field between the parallel pole faces of an electromagnet.** Nelson, D.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 14 Apr 1975. Contract W-7405-ENG-48. 53p. Dep. NTIS $5.75.

Thesis.

The design and evaluation of a system of coils for improving magnetic field homogeneity are discussed. Using only three coil-pairs the duration of NMR spin-echo signals from a sample of H_2O (0.7 cm. diameter x 0.9 cm. long) was increased by an order of magnitude. (auth)

00650 (UCID—16810) **Distortion in simulated alpha and FWHM measurements on OS-40 oscilloscopes linked in series.** Harper, T.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jun 1975. Contract W-7405-Eng-48. 26p. Dep. NTIS $4.50.

When a prompt diagnostic signal of the type recorded in underground nuclear tests is fed into a chain of OS-40 amplifiers linked in series, it is not recorded exactly the same from one oscilloscope to the next. This report describes a study in which a particular configuration of OS-40 oscilloscopes was used to record simulated alpha signals ranging from 2000 to more than 4000 μsec^{-1} and pulses having a FWHM of approximately 10 nsec. Alpha values of less than or equal to 2000 μsec^{-1} were recorded adequately by the stacked oscilloscopes, whereas for alpha values of 4000 μsec^{-1} and greater, serious degradation in the data was observed on all but the first scope in the chain. Peak width studies seem to indicate some broadening in the recorded FWHM the farther one proceeds along the oscillator chain.(auth)

EXPLOSIONS AND EXPLOSIVES

NUCLEAR

00651 (CONF-741001—, pp 80-86) **Finite element analysis of an underground protective test station subjected to severe ground motion.** Burchett, S.N.; Milloy, J.A.; Von Riesemann, W.A. (Sandia Labs., Albuquerque, NM). 1974.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Cube symposium, Lawrence Livermore Laboratory, October 23—25, 1974. Symposium proceedings.

A recoverable test station, to be used at a location very close to the detonation point of an underground nuclear test, was designed and tested. The design required that the station survive the very severe free-field stress and that the acceleration of the station be limited to a tolerable level. The predicted magnitude and time history of the free-field stress and acceleration indicated that the volcanic tuff medium and the materials of the proposed structure would exhibit nonlinear behavior, so that a transient dynamic analysis of a composite type structure involving nonlinear materials and large deformations was necessary. Parameter studies using a linear elastic dynamic finite element technique were first done to gain an understanding of the effect of the material properties and to study the response of various configurations of the protective structure to the transient loading. Based upon the results of these parameter studies and upon fielding considerations, a tentative design was chosen. This design was then evaluated using a newly developed finite element computer program. The results obtained from this analysis are compared to the field test results. (auth)

00652 (USGS—474-181) **Calculation of in SITU principal stress using secondary principal stress.** Brethauer, G.E.; Rosenbaum, J.G. (Geological Survey, Denver, Colo. (USA)). Jul 1975. 29p. Dep. NTIS $4.00.

A method is derived to determine principal stress magnitude and orientation at a particular location by using calculated secondary principal stresses that were obtained from overcoring stress relief measurements. A computer program based on this method is used to calculate the principal stress at various locations in Rainier Mesa, Nevada Test Site, using previously reported secondary principal stress values. (auth)

00653 (WASH—1526(Suppl.)DRAFT) **Underground nuclear testing program.** (Energy Research and Development Administration, Washington, D.C. (USA)). Jun 1975. 47p. USERDA, Washington, DC.

This Supplement extends the Environmental Statement (WASH- 1526) to cover all underground nuclear tests and preparations for tests of one megaton (1 MT) or less at the Nevada Test Site (NTS) during Fiscal Year 1976. If nuclear excavation tests or tests of yields above 1 MT should be planned, these will be covered by separate environmental statements. The test activities covered include chemical high explosive detonations done in connection with the nuclear testing program. (auth)

CIVIL USES

00654 (NVO—155(Vol.2)) **In situ leaching of a nuclear rubblized copper ore body. Volume II.** (USAEC Nevada Operations Office, Las Vegas; Kennecott Copper Corp., Lexington, Mass. (USA). Ledgemont Lab.; California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. Contract AT(26-1)-585. 333p. Dep. NTIS $19.75.

This volume contains detailed descriptions of technical and economical evaluations undertaken for the feasibility study. A summary of these results can be found in Vol. 1 along with the conclusions derived from the feasibility study and the recommendations tendered for future work. The sections of this study are presented in process order, and each section is complete in itself. The form of the presentation, hopefully, is logical and in a manner suitable for design purposes. As a further aid, each section has its own table of contents. The sections presented include method of attack, reference case, description of concept, nuclear rubblization, blasting plan, underground plumbing, fluid circulation, leaching technology, wellhead plant and pipeline, process plant, material and heat balance, hydrology, radioactivity, seismic, economics, sensitivity analysis, guide for environmental studies, exploration, and recommended experimental program. (TFD)

00655 (UCRL—51834) **Hybla Fair event: environmental report.** Roach, D.R.; Russell, W.L. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 May 1975. Contract W-7405-Eng-48. 14p. Dep. NTIS $4.00.

A series of environmental measurements during the Hybla Fair nuclear event were made. Experimenters were unsure of conditions that would be created since there was no closure system and the experiments were close to the source. A variety of temperature, pressure, and load devices were tested. The results will aid in the design and engineering of future close-in diagnostic packages and pipes. (auth)

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

00656 (DP-MS—75-75) **Environmental sciences and computations: a modular data based systems approach.** Crawford, T.V.; Bailey, C.E. (Savannah River Ecology Lab., Aiken, S.C. (USA)). Jul 1975. Contract AT(07-2)-1. 14p. (CONF-750706—8). Dep. NTIS $4.00.

From ERDA-wide conference on computer support on environmental science and analysis; Albuquerque, New Mexico, USA (9 Jul 1975).

A major computer code for environmental calculations is under development at the Savannah River Laboratory. The primary aim is to develop a flexible, efficient capability to calculate, for all significant pathways, the dose to man resulting from releases of radionuclides from the Savannah River Plant and from other existing and potential radioactive sources in the southeastern United States. The environmental sciences programs at SRP are described, with emphasis on the development of the calculational system. It is being developed as a modular data-based system within the framework of the larger JOSHUA Computer System, which provides data management, terminal, and job execution facilities. (auth)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

00657 (CONF-720805—P1, pp 279-303) **In-situ measurement of radionuclides in the environment wih a Ge(Li) spectrometer.** Anspaugh, L.R.; Phelps, P.L.; Gudiksen, P.H.; Lindeken, C.L.; Huckabay, G.W. (Univ. of California, Livermore). 1972.

From 2. conference on natural radiation environment; Houston, Texas, USA (7 Aug 1972).

Natural radiation environment II.

A portable Ge(Li) detector has proven to be a reliable and stable probe of the environmental radiation field, and can be calibrated using point sources and theoretical calculations to provide quantitative data on the presence of any gamma-emitting radionuclide in the earth's surface. The method is most accurate when applied to the naturally occurring radionuclides, and also provides limited ability to examine disequilibrium in the thorium-232 and uranium-238 radioactive series. A powerful advantage of the method is that results with the same precision can be obtained in about 0.01 of the time required by soil sampling and conventional laboratory analysis techniques. Measurements of potassium-40 and cesium-137 are included for comparison. The primary advantage of the Ge(Li) detector and the semitheoretical calibration approach is that complex mixtures of many radionuclides can be resolved and quantitated. (auth)

00658 (CONF-720805—P1, pp 317-332) **Geographical variations in environmental radiation background in the United States.** Lindeken, C.L.; Peterson, K.R.; Jones, D.E.; McMillen, R.E. (Univ. of California, Livermore). 1972.

From 2. conference on natural radiation environment; Houston, Texas, USA (7 Aug 1972).

Natural radiation environment II.

Based on a pilot thermoluminescent dosemeter (TLD) study conducted in the spring of 1971, environmental radiation background measurements made at 107 weather stations throughout the United States showed a median exposure rate of 9.4 μR/hr, with a range of 3.7 to 19.9 μR/hr. Measurements were made by mailing freshly annealed CaF_2:Dy (TLD-200) dosimeters to the stations where they were exposed in the station's instrument shelter. Following a three-month exposure, the dosimeters were returned to Livermore for readout. This pilot survey adequately demonstrated the capability of the procedure for large-scale synoptic background monitoring. Measurements can be made at little expense, and only modest field effort is involved. Indeed, the number of simultaneous measurements made in this survey would be patently impractical using portable instruments. Continuation of these quarterly measurements over a multi-year period would detect any systematic change in nationwide background, as well as provide a unified surveillance network to delineate the effect of a major nuclear accident within the United States. (auth)

00659 (TID—26794(Rev.)) **Hazards in plutonium dispersal.** Cohen, B.L. (Pittsburgh Univ., Pa. (USA)). Jul 1975. 48p. Dep. NTIS $5.50.

The health hazards to human populations from the dispersal of Pu in the environment are reviewed. Meteorological, and other factors, affecting the migration of Pu through soil-plant food chains to man are discussed, and an estimate is presented for the rate of cancer induction following ingestion of levels of ^{239}Pu that may be present in foods. The lethal dose of inhaled ^{239}Pu in personnel was also estimated. (CH)

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

00660 (UCRL—51830) **Examination of the geology and seismology associated with area 410 at the Nevada test site.** Hannon, W.J.; McKague, H.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 May 1975. Contract W-7405-Eng-48. 35p. Dep. NTIS $4.75.

This report summarizes regional and local geology at the Nevada Test Site and identifies major tectonic features and active faults. Sufficient information is given to perform seismic safety analyses of present and future critical construction at the Super Kukla Site and Sites A and B in Area 410. However, examination of local minor faults and joints and soil thickness studies should be undertaken at construction time. The Cane Spring Fault is identified as the most significant geologic feature from the viewpoint of the potential seismic risk. Predictions of the peak ground acceleration (0.9 g), the response spectra for the Safe Shutdown Earthquake, and the maximum displacement across the Cane Spring Fault are made. (auth)

CHEMICALS MONITORING AND TRANSPORT

00661 (UCRL--51837) **Toward a mathematical theory of environmental monitoring: the infrequent sampling problem.** Pimentel, K.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. Contract W-7405-eng-48. 404p. Dep. NTIS $10.60.

Thesis.

Optimal monitoring of pollutants in diffusive environmental media was studied in the contexts of the subproblems of the optimal design and management of environmental monitors for bounds on maximum allowable errors in the estimate of the monitor state or output variables. Concise problem statements were made. Continuous-time finite-dimensional normal mode models for distributed stochastic diffusive pollutant transport were developed. The resultant set of state equations was discretized in time for implementation in the Kalman Filter in the problem of optimal state estimation. The main results of this thesis concern the special class of optimal monitoring problem called the infrequent sampling problem. Extensions to systems including pollutant scavenging and systems with emission or radiation boundary conditions were made. (auth)

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

00662 (CONF-720805—P2, pp 457-481) **Geological factors controlling terrestrial gamma-ray dose rates.** Wollenberg, H.A.; Smith, A.R. (Univ. of California, Berkeley). 1972.

From 2. conference on natural radiation environment; Houston, Texas, USA (7 Aug 1972).

Natural radiation environment II.

The natural component of environmental gamma radioactivity measured on land depends mainly on the uranium, thorium, and potassium contents of the rock and soil. The distribution and abundance of these radioelements in turn depend on whole-rock chemistry, which, in many cases, may be related to global tectonic features. Western North America, presently undergoing active tectonism, contains a wide variety of rock types. Data are presented on rocks of California and western Nevada that cover a broad range in lithology, from ultramafic to granitic plutonic igneous rocks and from carbonate to siliceous clastic sedimentary rocks. The exposure rate histograms of the rock types containing appreciable radioactivity are shown. Within these categories, natural radioelement contents and associated gamma-ray exposure rates also vary over broad ranges; for example, in plutonic rocks over an order of magnitude between low-radioactivity diorites and gabbros and more radioactive quartz monzonites and granites. It has also been observed that volcanic rocks vary in radioactivity similar to their plutonic counterparts. (auth)

00663 (LA-UR—75-872) **Theoretical, analytical, and statistical interpretation of environmental data.** Lombard, S.M. (Los Alamos Scientific Lab., N.Mex. (USA)). 1974. Contract W-7405-eng-36. 16p. (CONF-7406104—1). Dep. NTIS $4.00.

From Southeastern seminar on environmental radiation surveillance; Columbia, South Carolina, USA (Jun 1974).

The reliability of data from radiochemical analyses of environmental samples cannot be determined from nuclear counting statistics alone. The rigorous application of the principles of propagation of errors, an understanding of the physics and chemistry of the species of interest in the environment, and the application of information from research on the analytical procedure are all necessary for a valid estimation of the errors associated with analytical results. The specific case of the determination of plutonium in soil is considered in terms of analytical problems and data reliability. (auth)

SOIL

00664 (LBL—3646) **Status of the GEODOSE Project.** Wollenberg, H.A.; Fitzpatrick, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. Contract W-7405-eng-48. 17p. (CONF-750671—1). Dep. NTIS $4.00.

From International symposium on areas of high natural radioactivity; Pocos de Caldas, Brazil (16 Jun 1975).

The evaluation of the impact of man upon the natural gamma-radiation environment requires a clear understanding of the distribution and abundance of the natural radioelements in rocks and soils. The GEODOSE Project is an attempt to characterize rock and soil types by their natural gamma-ray exposure rates. The world's geochemical literature is being searched for data on K, U, and Th contents of earth materials, and these data are categorized by rock type, based on standard petrologic classifications. A data bank is being assembled, presently incorporating radioelement information on the igneous rocks. The data are treated to produce computer plots of histograms of K, U, Th contents, calculated gamma-ray exposure rates, and radiogenic heat production for given rock types. (auth)

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

00665 (BNWL-SA—5403) **Techniques for long-term controlled studies of plant uptake of transuranics.** Hinds, W.T.; Cline, J.F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. 17p. (CONF-750503—26). Dep. NTIS $4.00.

From 4. national symposium on radioecology; Corvallis, Oregon, USA (12 May 1975).

The development of techniques and equipment for determining the fate of transuranics released into terrestrial ecosystems is discussed. Experimental facilities at Hanford are described. Evidence that processes associated with weathering, or aging, or both, can increase the uptake of transuranics from soil by plants is discussed. (CH)

00666 (NVO—269-23) **Amchitka radiobiological program progress report, January 1974—December 1974.** Nelson, V.A.; Seymour, A.H. (Washington Univ., Seattle (USA). Coll. of Fisheries). May 1975. Contract AT(26-1)-269. 52p. Dep. NTIS $4.00.

Results are summarized of analyses of samples collected from 1970 to 1974 in the Amchitka Island area and include analyses for gamma-emitting radionuclides in air filters, seawater, freshwater, birds, lichens, marine algae, marine invertebrates, fish, aufwuchs, and freshwater moss and plants; ^{90}Sr in rats and birds; and tritium in seawater, freshwater, and biological organisms. Monitoring of background radiation with survey instruments was added to the 1974 program and the results of the survey are included. (auth)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

00667 (DP—1385) **Short climatology of the atmospheric boundary layer using acoustic methods.** Schubert, J.F. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jun 1975. Contract AT(07-2)-1. 20p. Dep. NTIS $4.00.

A climatology of the boundary layer of the atmosphere at the Savannah River Laboratory is being compiled using acoustic methods. The atmospheric phenomenon as depicted on the facsimile recorder is classified and then placed into one of sixteen categories. After classification, the height of the boundary layer is measured. From this information, frequency tables of boundary layer height and category are created and then analyzed for the percentage of time that each category was detected by the acoustic sounder. The sounder also accurately depicts the diurnal cycle of the boundary layer and, depending on the sensitivity of the system, shows microstructure that is normally unavailable using other methods of profiling. The acoustic sounder provides a means for continuous, real time measurements of the time rate of change of the depth of the boundary layer. This continuous record of the boundary layer with its convective cells, gravity waves, inversions, and frontal system passages permits the synoptic and complex climatology of the local area to be compiled. (auth)

ENVIRONMENTAL SCIENCES, AQUATIC

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

WATER

00668 (COO—3566-11) **Distribution of lead-210 and polonium-210 between soluble and particulate phases in seawater.** Spencer, D.W. (Woods Hole Oceanographic Institution, Mass. (USA)). 1975. 105p. Dep. NTIS $8.25.

Results are reported from radiometric measurements of the distribution of ^{210}Pb and ^{210}Po in surface seawater and suspended particulate matter. Samples of plankton and sediments collected from some locations were also analyzed. Samples of seawater and suspended particulate matter were collected from stations located in the Gulf of Maine, the North Atlantic, and approximately 500 miles southwest of Gilbraltar. (CH)

AQUATIC ECOSYSTEMS AND FOOD CHAINS

00669 (UCRL—76570(Rev.2)) **Role of solubles and particulates in radionuclide accumulation in the oyster Crassostrea Gigas in the discharge canal of a nuclear power plant.** Harrison, F.L.; Wong, K.M.; Heft, R.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Aug 1972. 39p. (CONF-750503—26). Dep. NTIS $5.00.

From 4. national symposium on radioecology; Corvallis, Oregon, USA (12 May 1975).

Changes in ^{54}Mn, ^{60}Co, ^{65}Zn, and ^{137}Cs concentrations were followed in oysters introduced into a discharge canal receiving low-level radioactive waste from a boiling water reactor. Groups of animals were maintained either in filtered or nonfiltered discharge-canal water. They were sampled immediately before and after single radioactive releases and at one-day intervals thereafter. Radionuclide concentrations were determined also in the water and in suspended and settled particulates. In the canal water, concentrations changed rapidly during a release, reaching peak values within 30 minutes. The partition between soluble and particulate (filterable) phases in the water differed with the radionuclide. Continuous sampling of suspended particulates after single releases showed considerable variation in concentrations per liter of water for each radionuclide. Comparisons of animals held in filtered water to those in nonfiltered water showed similar concentrations only for ^{137}Cs. Results indicate that suspended particulates play an important role in the accumulation of some radionuclides and that resuspension of particulates is an important source between periods of releases. (auth)

THERMAL EFFLUENTS MONITORING AND TRANSPORT

00670 (CONF-750425—7) **Growth of salmonid fishes from heated and unheated areas of Lake Michigan: as measured by RNA-DNA ratios.** Spigarelli, S.A.; Smith, D.W. (Argonne National Lab., Ill. (USA)). 1975. 21p. Dep. NTIS $4.25.

From 2. Thermal ecology symposium; Augusta, Georgia, USA (2 Apr 1975).

Relative growth rate comparisons were made between tagged thermal plume resident fish and fish collected from two ambient temperature areas (control). Plume fish were tagged, released and subsequently recaptured in the thermal discharge area of the Point Beach Nuclear Plant (near Two Rivers, Wisconsin). Total tag days indicated minimum residence time and temperature-sensitive tags gave estimates of time spent at discharge temperatures. Growth rate estimates were based on RNA-DNA ratios in epaxial muscle samples taken from brown and rainbow trout and chinook salmon. Mean RNA-DNA ratios of plume rainbow trout and chinook salmon were not significantly different from mean ratios of combined control groups for each species. The mean ratio of plume brown trout was significantly higher than that of combined control fish. Significant differences between mean ratios of control groups for each species suggest considerable natural variability in growth rates among individuals of a population. (auth)

00671 (COO—2002-24) **Thermal regulation of functional groups in running water ecosystems. Progress report, 1974—1975.** Cummins, K.W.; Klug, M.J. (Michigan State Univ., Hickory Corners (USA). W.K. Kellogg Biological Station). 1975. Contract E(11-1)-2002. 23p. Dep. NTIS $4.25.

Upper and lower thermal limits and temperature dependent growth were determined for a number of organisms (or populations) representing various functional groups of stream ecosystems (microconsumers, producers, and macroconsumers, shredders, collectors, scrapers, and predators). Although temperature functions as an overall control parameter, organic substrate (microconsumers) and inorganic nutrients (microconsumers and producers), light (producers) and food quality (macroconsumers) can modify thermal responses. Stream microorganisms typically grow below their thermal optima, community composition being determined by those that can manage the maximum growth at a given temperature utilizing a given organic substrate. Producers in first to third order streams are generally light limited (although nutrient availability is also important). Food quality, primarily a function of microbial biomass in the case of detritivores. can compensate for temperature dependent growth in non-predator macroinvertebrate functional groups. (auth)

BIOMEDICAL SCIENCES, BASIC STUDIES

BIOCHEMISTRY

00672 (COO—3085-43) **Regulations of enzymes in animals: effects of developmental processes, cancer, and radiation. Comprehensive three-year progress report, 1 May 1972—30 April 1975.** Knox, W.E. (New England Deaconess Hospital, Boston, Mass. (USA). Cancer Research Inst.). 1975. Contract E(11-1)-3085. 31p. Dep. NTIS $4.75.

Controls by genes and by adaptive phenomena of the patterns of enzymes in several rat tissues were extended by systematic investigations during development, in neoplasms, and after x-irradiation. Newly developed quantitative assays for tryptophan pyrrolase and phenylalanine hydroxylase were used to study the mechanism of degradation after induction of the former enzyme. Systematic investigation of the isoenzymic variants and of the quantitative pattern of enzymes in numerous rat tissues led to the discovery of new variants, the determination of the functional role of certain enzymes in specific tissues, and the identification of enzymes whose amount provides sensitive indicators fo neoplastic growth in rat liver and spleen. X-irradiation of young postnatal rats interfered with the development of some hepatic enzymes. This effect was distinct from that of tumor-bearing, and from abnormal hormonal or nutritional conditions. (auth)

TRACER TECHNIQUES

00673 (UR—3055-14) **Characterization of an organ-specific differentiator substance.** Steele, V.E. (Rochester Univ., N.Y. (USA). Dept. of Radiation Biology and Biophysics). 1975. 150p. Dep. NTIS $10.50.

Thesis.

Cell regeneration in planaria (Dugesia etrusca) was studied. An attempt was made to characterize a diffusible brain inhibitory substance, to elucidate its role in the maintenance of anterior-posterior polarity during head or tail regeneration, and to utilize its action in measuring the differentiative integrity of the stem cells following x-irradiation. (CH)

MEDICINE

00674 (COO—3234-25) **Physiopathology of blood platelets and development of platelet substitutes. Progress report, August 1, 1974—July 31, 1975.** Baldini, M.G. (Brown Univ., Providence, R.I. (USA)). 1975. Contract AT(11-1)-3234. 49p. Dep. NTIS $5.50.

Progress is reported on investigations of methods for the storage of human blood platelets. Good results were obtained when platelets were frozen using 5 percent dimethyl sulfoxide (DMSO) as a cryoprotective agent. There was no evidence of toxic effects of trace amounts of DMSO in experimental animals. Blood platelet storage at 22°C with nucleotide additives in the storage medium was also investigated. The effects of x irradiation at doses varying from 100 to 1000 R on the aggregation of blood platelets following exposure in vitro and the effect of Vitamin E as an antiaggregating agent were studied. (CH)

TRACER TECHNIQUES

00675 (BNL—20062) **Quantitation of the degree of osteoporosis by measure of total-body calcium employing neutron activation.** Cohn, S.H.; Zanzi, I.; Vaswani, A.; Wallach, S.; Aloia, J.; Ellis, K.J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 8p. (CONF-750557—1). Dep. NTIS $4.00.

From 11. European symposium on calcified tissues; Elsinore, Denmark (25 May 1975).

Two techniques for measuring the amount of Ca in the total skeleton were employed: total-body neutron activation analysis (TBNAA) and the determination of the mineral content of a bone of the appendicular skeleton (absorptiometric measurement of the radius, BMC). (auth)

00676 (CONF-750465—1) **Radionuclide computerized tomography for brain study.** Kuhl, D.E.; Edwards, R.Q.; Alavi, A.; Reivich, M.; Rothenberg, H. (Pennsylvania Univ., Philadelphia (USA). Dept. of Radiology). 16 Apr 1975. 23p. Dep. NTIS $4.25.

From Workshop on reconstruction tomography in diagnostic radiology in nuclear medicine; San Juan, Puerto Rico (17 Apr 1975).

The diagnostic value of /99m/Tc-pertechnetate computerized tomographic brain scans for measurements of regional blood flow, blood volume, membrane permeability, and inflammation is discussed. (CH)

00677 (TID—3319-S6) **Bibliography on nuclear medicine. Volumes 28—30.** (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jul 1975. 379p. Dep. NTIS $10.60.

References to 3177 publications related to nuclear medicine announced in Nuclear Science Abstracts (NSA) volumes 28(July-Dec. 1973), 29(Jan-June 1974), and 30(July-Dec. 1974) are contained in this bibliography. Subject, report number, and personal author indexes are included. (CH)

MICROBIOLOGY

00678 (LBL—2874) **Electron microscopy at reduced levels of irradiation.** Kuo, I.A.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1975. Contract W-7405-ENG-48. 124p. Dep. NTIS $9.25.

Thesis.

Specimen damage by electron radiation is one of the factors that limits high resolution electron microscopy of biological specimens. A method was developed to record images of periodic objects at a reduced electron exposure in order to preserve high resolution structural detail. The resulting image would tend to be a statistically noisy one, as the electron exposure is reduced to lower and lower values. Reconstruction of a statistically defined image from such data is possible by spatial averaging of the electron signals from a large number of identical unit cells. (auth)

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

00679 (COO—2362-7) **Basic aspects of radiation action on microorganisms. Progress report, April 1, 1974—March 31, 1975.** Pollard, E.C. (Pennsylvania State Univ., University Park (USA). Dept. of Biophysics). Apr 1975. 39p. Dep. NTIS $5.00.

Progress is reported on the following research projects: effects of blocking DNA synthesis by hydroxyurea on induction of lambda phage; dose response curves for uv and ionizing radiation with radiosensitive and radioresistant strains of phage; effects of oxygen, rifampin, and hydrogen peroxide on induction of radioresistance; radioinduced degradation of DNA; and induction of repair system of mutagenesis with uv and ionizing radiation. (HLW)

00680 **Ultraviolet carcinogenesis.** Rosen, P. (Oak Ridge National Lab., TN). *Int. J. Quant. Chem.*; 9: No. 3, 473-478(May 1975).

A theory of uv carcinogenesis is described in which damage to DNA in the form of pyrimidine dimers occurs in a critical operator region of the genome that controls the synthesis of divisional proteins. There is a chance that a mutation will occur in the region of the operator either during replication or during postreplication repair, so that unchecked growth will be passed on to daughter cells. Comparison with the experiments of Hart and Setlow (1973) indicates that agreement is semiquantitative. (auth)

RADIATION EFFECTS ON PLANTS

BASIC STUDIES

00681 (COO—2283-5) **Response of a forest ecotone to ionizing radiation. Progress report, 15 October 1974—14 October 1975.** Murphy, P.G. (Michigan State Univ., East Lansing (USA). Dept. of Botany and Plant Pathology). 1975. Contract E(11-1)-2283. 5p. Dep. NTIS $4.00.

Compositional and structural characteristics of three forest types, including aspen dominated, maple-birch dominated and an intervening ecotone, were studied before and after chronic γ irradiation in northern Wisconsin. Irradiation occurred during the summer of 1972. By the summer of 1973 the density of viable tree seedlings at 10 m from the radiation source was substantially reduced in all three areas relative to the preirradiation densities of 1971. Re-establishment of tree seedlings has, as of June 1975, been prevented by the vigorous development of ground vegetation. At 20 m, the density of seedlings in the three areas increased during the period between 1971 and 1973 in response to the partially opened canopy. The overall density of seedlings of Populus tremuloides and Acer rubrum increased markedly in the three areas and P. tremuloides invaded some areas in which it had not been found prior to irradiation. By 1974 many of the seedlings at 20 m had reached the sapling size-class. Viable trees greater than 2.5 cm, dbh were eliminated at 10 m in all three areas by June 1974 and were reduced in density of 20 m. Leaf litter production was reduced by up to 94 percent at 10 m and 64 percent at 20 m during the period between 1971 and 1973 in the irradiated areas. (auth)

00682 (COO—2283-6) **Response of a forest ecotone to ionizing radiation. Summary report, 15 October 1972—14 July 1975.** Murphy, P.G. (Michigan State Univ., East Lansing (USA). Dept. of Botany and Plant Pathology). 1975. Contract E(11-1)-2283. 26p. Dep. NTIS $4.50.

Compositional and structural characteristics of three forest types, including aspen dominated, maple-birch dominated, and an intervening ecotone, were studied before and after chronic γ irradiation in northern Wisconsin. Irradiation occurred during the summer of 1972. By the summer of 1973, the density of viable tree seedlings at 10 m from the radiation source was substantially reduced in all three areas relative to the preirradiation densities of 1971. Re-establishment of tree seedlings has thus far been prevented by the vigorous development of ground vegetation at 10 m. At 20 m, the density of seedlings in the three areas increased during the period between 1971 and 1973 in response to the partially opened canopy. Leaf litter production was reduced by up to 94 percent at 10 m and 64 percent at 20 m during the period between 1971 and 1973 in the irradiated areas. (auth)

RADIATION EFFECTS ON ANIMALS

MAN

00683 (COO—2536-1) **Study of radiation dose from radioactive shipments to cargo handlers at O'Hare Field.** (Northwestern Univ., Evanston, Ill. (USA)). Jun 1975. 40p. Dep. NTIS $5.00.

The relationship between the amount of radioactive materials that pass through the cargo areas at O'Hare Field, Chicago, and the resulting radiation dose to the workers handling the packages was determined. Measurements of radiation exposure rates at various distances from the radioactive packages were made. Handling or exposure times for personnel during several unit operations were measured with a watch. These data were used to determine the body dose from the unit operation. In randomly selected cases workers were assigned TLD dosimeters in the form of a ring to be worn on the hand or in the form of a clip to be attached to the clothing for measurement of the hand or body dose from a unit operation. During each survey, several workers were given TLDs that were worn for the duration of the shift, and some workers, in addition, were given dosimeters to be worn for the duration of the study. Results showed that the workers who handled the radioactive packages did not receive any significant radiation exposure. (CH)

00684 (ORNL-tr—4010) **Residual radiation from the atomic bomb at Hiroshima.** Takeshita, K. Translated by H. Kubota from *Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo;* 13: 1-8(1972). 14p. Dep. NTIS $4.00.

Estimates are presented on the radiation dose rates to the population due to external radiation during the first few days following the explosion of an atomic bomb at Hiroshima. All available data on induced radioactivity in the region centered on the epicenter and the distribution of radioactive fallout were used for estimates of the dose rate to the population in various locations of the city and early entrants to the city. (CH)

00685 **Radiobiological assessment of the spatial distribution of radiation dose from inhaled plutonium.** Blair, W.J.; Richmond, C.R.; Wachholz, B.W. (Atomic Energy Commission, Washington, DC). pp vp of **Plutonium, safeguards, and the breeder.** New York; Atomic Industrial Forum, Inc. (1975).

From AIF public affairs workshop on plutonium, safeguards, and the breeder; Knoxville, Tennessee, USA (8 Oct 1974).

See CONF-7410119—.

Permissible limits for the respiratory intake of radioactive materials are commonly calculated on the assumption of complete absorption of the radiation energy by the critical organ and that there is a uniform distribution of energy deposition throughout the organ. The consequences of basing an evaluation of the effects of inhaled plutonium on these assumptions is examined. It is concluded that the nonuniform dose distribution of plutonium particles in the lung is not more hazardous, and may be less hazardous, than if the plutonium were uniformly distributed. It is stated that the mean dose lung model is a radiobiologically sound basis for establishment of plutonium standards. (SFL)

VERTEBRATES

00686 (CONF-751001—1) **Influence of WR-2721 on metastatic tumor spread after irradiation.** Ullrich, R.L.; Jernigan, M.C.; Yuhas, J.M. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From 3. annual meeting of the southeastern cancer research association; Atlanta, Georgia, USA (2 Oct 1975).

The Line 1 alveolar cell carcinoma is a transplantable murine tumor which, unlike most others, kills the host by means of metastatic spread. Attempts to cure this tumor with localized radiation therapy often fail, in spite of local tumor control, because the metastases evade the treatment. These facts suggest that host-tumor interactions may play a particularly important role in determining the ultimate survival of the tumor bearing animal. In order to initially evaluate the possible importance of normal regional tissues in host-tumor interactions the influence of WR-2721, a radioprotective drug, was examined for local tumor control and subsequent survival of the tumor bearing animal after localized radiation. Results indicated that WR-2721 can decrease metastasis. (CH)

00687 (COO—3085-42) **Regulations of enzymes in animals: effects of developmental processes, cancer and radiation. Progress report IX, 1 May 1974—31 April 1975.** Knox, W.E. (New England Deaconess Hospital, Boston, Mass. (USA). Cancer Research Inst.). 1975. Contract E(11-1)-3085. 15p. Dep. NTIS $4.00.

Investigations of the properties of variant forms of emnzymes in rat tissues were continued. Two glutamyltransferases, one which remains associated with glutamine synthetase and the other which can be separated from it, were purified. A new assay method forglutaminase activity was established which facilitated further characterization of the 3 isozymes and their concentration in normal and neoplastic tissues. Studies of arginase led to the demonstration of the role that the new variant of arginase plays in proline synthesis in mammary gland. An inhibitor of asparagine synthetase, which is absent from fetal liver and tumors, was discovered in adult rat liver. Peptidyl proline hydroxylase (an essential enzyme in collagen synthesis) was identified as one of the most sensitive indicators of neoplastic growth. The spectrum of experimental, transplantable rat tumors was extended to a series of salivary gland tumors and a radiation-induced lymphoma. (auth)

00688 (COO—3380-17) **Dose and recovery in rat skin tumor induction: data and a method of analysis.** Albert, R.E.; Burns, F.J. (New York Univ., N.Y. (USA). Inst. of Environmental Medicine). 1975. 14p. (CONF-750473—1). Dep. NTIS $4.00.

From Meeting on influence of radiobiological factors in estimation of risks of cancer induction for purposes of radiological protection; Brighton, UK (2 Apr 1975).

Results are reported from a number of studies on the carcinogenic effects of various doses of electrons, 10 MeV protons,

and 40 MeV alpha particles in rat skin following either single or fractionated exposures. The incidence of tumors was determined for periods up to 80 weeks and a mathematical model for tumor induction was developed. (CH)

00689 (COO—3380-22) **Tumorigenic action of beta, proton, alpha, and electron radiation on the rat skin. Progress report, August 1, 1974—July 31, 1975.** Albert, R.E.; Burns, F.J. (New York Univ., N.Y. (USA). Inst. of Environmental Medicine). 1975. Contract AT(11-1)-3380. 16p. Dep. NTIS $4.00.

The carcinogenic effects of ionizing radiation (α, β, electron, and protons) on rat skin were studied in an attempt to learn more about radiation carcinogenesis, especially how various parameters of the irradiation, such as dose distribution within the tissue and dose rate, affect the yield of tumors. It was found that when the dose was localized to a small region of skin, the tumor yield was reduced and the magnitude of the reduction indicated that the region of reduced response might extend about 150 μ into the irradiated zone. The proliferative state of the hair follicles at the time of irradiation had relatively little effect on tumor induction although old animals were less susceptible than young or newborn animals. The penetration requirement of at least 0.3 mm for producing tumors suggests that the hair follicle germ cells could be the oncogenic targets. Comprehensive experiments to measure the rate of recovery for tumor induction in split-dose exposure protocols indicated a recovery halftime of about 4 hrs for electrons and significant recovery for protons, which was used in a model to predict how recovery should affect the tumor response at low dose rates. Combinations of ionizing radiation and ultraviolet light were applied to rat skin to determine whether they are additive for producing tumors. (auth)

00690 (SAN—899X3) **Observations on hemopoietic marrow. Comprehensive report, July 1972—June 1975.** (Scripps Clinic and Research Foundation, La Jolla, Calif. (USA)). Jun 1975. Contract AT(04-3)-899. 18p. Dep. NTIS $4.00.

Progress is reported on studies on the relationship between the structure of hemopoietic tissues and hemopoiesis. Cytochemical and histochemical methods were used for the classification of acute leukemias according to cell type and identification of the site of involvement of spleen cells in Hodgkin's and non-Hodgkin's lymphoma. The structure and function of bone marrow adipose cells were characterized. Results are reported from studies on the growth of bone tissues in previously whole-body (500 to 850 rads) irradiated mice following the implantation of isologous bone marrow. (CH)

00691 (UR—3055-15) **Possible relationships between the early inflammatory response and subsequent fibrosis in rat skin after irradiation.** Ullrich, R.L. (Rochester Univ., N.Y. (USA). School of Medicine and Dentistry). 1975. 143p. Dep. NTIS $10.25.

Thesis.

The possible mechanistic relationships between the early inflammatory response and subsequent fibrosis seen after radiation exposure was studied in rats were given single x ray doses of either 2000 or 5000 rads to standardized fields of the inner thigh. The results suggest that two mechanisms are responsible for the radiation-induced increase in extravasation rate and vascular injury seen early after irradiation. First, direct cytocidal damage of the endothelium; and second, chemically mediated, possibly complement dependent mechanisms. Indirect histological evidence suggests a correlation between the PMN infiltrate and the indirect vascular damage. In addition, one may conclude from these data that both direct and indirect damage to the vasculature play a role in influencing the subsequent late radiation-induced fibrosis; and a decrease in the indirect damage may allow the maintenance of a supportive vasculature at lower doses or allow the reestablishment of a vascular bed in the case of higher doses. (CH)

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

00692 (LBL—3388) **Three-dimensional image reconstruction using pinhole arrays.** Chang, L.T.; Macdonald, B.; Perez-Mendez, V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 10 Feb 1975. Contract W-7405-eng-48. 4p. (CONF-750426—2). Dep. NTIS $4.00.

From International optical computing conference; Washington, District of Columbia, USA (23 Apr 1975).

From multiple single-pinhole exposures of a three dimensional object, taken with a position-sensitive gamma-ray detector, tomographic images of radionuclide distribution in patients during diagnostic tests are formed with the aid of a computer. The effects of obscuring, offplane activity are removed for a number of transverse planes through the object in a three dimensional image reconstruction method which uses the tomographic images as input. Lateral resolution, detector counting rate, total exposure times, and statistical accuracy of the final image are comparable to those of the single pinhole camera. The mathematical technique of the reconstruction method is applicable to images produced by a number of tomographic imaging devices. (auth)

ANIMALS

00693 (COO—2506-1) **Biological effects of implanted nuclear energy sources for artificial heart devices. Progress report, September 1, 1974—August 31, 1975.** Kallfelz, F.A.; Wentworth, R.A.; Cady, K.B. (New York State Veterinary Coll., Ithaca (USA). Dept. of Physical Biology). 1975. Contract E(11-1)-2506. 84p. Dep. NTIS $7.25.

Results are reported from a study of the biological effects of radiation from mock plutonium power sources in dogs and a study of the feasibility of a tissue heat sink for waste heat from such sources in calves. It is also designed to evaluate effects of heat and radiation from plutonium sources in calves. The work is part of a program to evaluate the use of plutonium as a power source for an artificial heart device. A total of 60 dogs have been implanted with mock plutonium sources (producing a similar radiation flux as plutonium but having no associated heat) at levels of from 1 to 70 times the expected radiation flux from a 30 watt plutonium source. Results up to 4.5 years after implantation indicate that mammals may be able to tolerate the radiation flux from such sources. Results in calves indicate that 30 watts of additional endogenous heat can be dissipated to a connective tissue covered heat exchanger with a surface area of 494 cm^2 providing a heat flux of 0.06 $watts/cm^2$. (auth)

00694 (LA-UR—75-1324) **Lung response to localized irradiation from plutonium microspheres.** Anderson, E.C.; Holland, L.M.; Prine, J.R.; Thomas, R.G. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 6p. (CONF-750917—1). Dep. NTIS $4.00.

From 4. international symposium on inhaled particles and vapours; Edinburgh, Scotland, UK (22 Sep 1975).

Uniform spherical 10-μm diameter particles of ZrO_2 ceramic, containing various concentrations of PuO_2, have been injected into the jugular vein of Syrian hamsters with subsequent permanent lodgment in the lung capillaries. The number of particles injected has varied from 2000 to 2,000,000, and the specific activity has been from 0.1 to 100 pCi/sphere so that lung burdens range from 0.2 to 1000 nCi. To date, approximately 3000 hamsters have been committed to the experiment and two-thirds have died— the expected rate for normal animals. Little biological damage has been observed, and only five primary lung tumors have been found that may be due to radiation delivered to the lung. To provide a comparison to more uniform radiation, soluble polonium has also been instilled intratracheally. Results from the microspheres suggest that localized lung irradiation alone is not sufficient cause for tumor induction and is much less hazardous than diffuse exposure. (auth)

NUCLIDE KINETICS AND TOXICOLOGY

ANIMALS

00695 (BNWL-SA—5170) **Disposition of highly toxic radioactive aerosols inhaled by beagle dogs.** Craig, D.K.; Decker, J.R.; Powers, G.J.; Park, J.F. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract AT(45-1)-1830. 20p. (CONF-750707—2). Dep. NTIS $4.00.

From Annual meeting of the Health Physics Society; Buffalo, New York, USA (13 Jul 1975).

Beagle dogs were exposed to ^{241}Am or ^{244}Cm oxides in an apparatus which permitted separation of expired from inspired air and measurement of these volumes, the aerosol concentrations, and their size distributions. Following exposure, excreta were collected and analyzed for 30 days and for a week prior to sacrifice. Activity in the lungs was estimated from periodic thorax counts, while complete tissue analyses were conducted on groups of 3 dogs sacrificed 10, 30, 90, and 270 days postexposure. Indications from the early thorax counts, excreta, and tissue analyses showed that $^{244}CmO/sub\ x/$ aerosols having AMAD = 0.5 μm and GSD = 2.1, initial alveolar deposition varied from 40 percent for the low level (10 nCi) to 20 percent for the high level (400 nCi); after early ciliary clearance, as much ^{244}Cm was excreted in the urine as in the feces; at 10 days postexposure, 25 to 35 percent was still in the lung with 45 to 65 percent in other soft tissues and 10 to 30 percent in the skeleton. For $^{241}AmO_2$, the size distribution was a func-

tion of aerosol concentration, with AMAD = 0.7 μm and GSD = 2.4 at the low level (1 nCi), increasing to 1.35 μm and 1.7 at intermediate levels (125 nCi), and 1.45 μm and 1.7 at the high level (1150 nCi); corresponding mean alveolar depositions were 15, 30, and 35 percent. The ^{241}Am or ^{244}Cm tissue distribution analyses at various times post-exposure showed that both isotopes are readily translocated from the lungs to liver, skeleton, and muscle, ^{244}Cm twice as rapidly as ^{241}Am. (auth)

00696 (BNWL-SA—5296) **Influence of inhaled Ca-DTPA on the long-term effects of inhaled Pu nitrate.** Ballou, J.E.; Dagle, G.E.; McDonald, K.E.; Buschbom, R.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract AT(45-1)-1830. 15p. (CONF-750707—4). Dep. NTIS $4.00.

From Annual meeting of the Health Physics Society; Buffalo, New York, USA (13 Jul 1975).

Inhaled Ca-DTPA administered to rats in 6 weekly, one-hour treatments of 3 mg/rat did not affect weight gain or life-span compared to Pu burdened animals (78 nCi ILB) or nontreated controls. In addition, the drug did not appear to promote the development of malignant lung tumors and bone tumors in Pu burdened rats although one rat exposed only to Ca-DTPA aerosols did develop a malignant lung tumor. This single lung tumor can not be considered significant although the normal incidence of this lesion is quite low. Inhaled Ca-DTPA therapy administered 20 days after Pu inhalation showed little effect in reducing the lung burden of plutonium. Skeletal deposition was decreased possibly because Ca-DTPA was administered during a time of active translocation of the inhaled Pu when Pu may have been available for chelation in the blood. Inhaled Ca-DTPA therapy did not appear to be beneficial in reducing the number of malignant lung tumors or bone tumors in plutonium burdened rats but on the other hand the chelate did not appear to promote these lesions. (auth)

00697 **Electron diffraction study of plutonium oxide particulates in dog lymph tissue.** Hillyer, R.F.; Dagle, G.E. (Dow Chemical U.S.A., Golden, CO). Contract AT(29-1)-1106. pp 197-205 of **Microstructural science. Volume 2.** Fritzke, G.P. (ed.). New York; American Elseiver Publishing Company, Inc. (1974).

From 6. meeting of International Metallographic Society of America; Los Angeles, California, USA (25 Sep 1973).

See CONF-730973—.

Popliteal lymph-node sections from Beagle dogs were examined with the electron microscope in order to define localized particulates. By means of autoradiography, particulates in the lymph tissue had been determined previously to be alpha emitters)radioactive). However, with electron diffraction, the particulates have been identified as plutonium oxide (PuO_2). (auth)

PLANTS

00698 (LBL—3217, pp 236-239) **Nitrate movement and plant uptake of N in a field soil receiving ^{15}N-enriched fertilizer.** Broadbent, F.E.; Krauter, C. (Univ. of California, Davis). 1974.

From 2. annual NSF-RANN trace contaminants conference; Pacific Grove, California, USA (29 Aug 1974).

Trace contaminants in the environment.

A plot of 13.9 m^2 on Yolo fine sandy loam was fertilized with $(NH_4)_2SO_4$ containing 8.04 atom percent excess ^{15}N at the rate of 112 kg N/hectare and planted first to wheat and then to corn. The plot was surrounded by a buffer zone of 405 m^2 which was treated in identical fashion except that unlabeled fertilizer was used. Porous ceramic probes for measuring soil moisture tension and for extraction of soil solution were installed depths from 15 to 180 cm. Harvested crops were analyzed for ^{15}N as were soil cores taken after crop harvest. Nitrate-N concentrations in the soil solution at 15 cm ranged from a maximum in March of 70 ppM, of which 39 ppM was derived from fertilizer, to a minimum of 0.2 ppM in July. The largest amount of fertilizer-derived NO_3-N at 180 cm was 0.28 percent of that applied, contributing 0.36 ppM to the concentration at that depth. The wheat crop removed 32.3 percent of the fertilizer N and the corn crop utilized 22.8 percent. Organic and inorganic N remaining in the soil after cropping represented 32.9 percent of the applied N, leaving 12.0 percent unaccounted for. The consistently low nitrate concentrations at 180 cm suggest that this deficit was not due to leaching, and should be attributed to denitrification. (auth)

00699 (LBL—3217, pp 333-339) **Use of ^{210}Pb and ^{109}Cd isotopes in a preliminary study of their uptake and translocation by plants.** Rule, J.; Hemphill, D.; Pierce, J.O. (Univ. of Missouri, Columbia). 1974.

From 2. annual NSF-RANN trace contaminants conference; Pacific Grove, California, USA (29 Aug 1974).

Trace contaminants in the environment.

Leaf lettuce and white icicle radish were grown under greenhouse culture for a period of three and one-half weeks. Appropriate solutions of Pb $(NO_3)_2$ or $CdCl_2$ were applied to foliage via a micropipette. These solutions also contained radioisotopes of Pb or Cd. The plants were grown for an additional three and one-half weeks, harvested and analyzed. Results of autoradiography and scintillation analyses of the radioisotopes showed foliar absorption and subsequent translocation of both metals. In the lettuce the greatest translocation was to the youngest leaves of the plant and in the radish to the storage root, in both cases the edible portion of these plants. Thus, it seems that foliar absorption of heavy metals may well be an important source of contamination of radish and leaf lettuce. (auth)

00700 (ORNL-EIS—75-77) **Radionuclide movement in soils and uptake by plants. A selected, annotated bibliography.** Francis, C.W.; Talmage, S.S.; McMullin, B.B. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. 371p. Dep. NTIS $21.75.

This bibliography covers the world literature from 1948 to 1975 and contains 1397 references to information on how various chemical, physical, and biological factors influence the movement of radionuclides in soil and uptake by plants. Much of the data is related to the major fission products in radioactive fallout, with emphasis on ^{137}Cs and ^{90}Sr. References are included to data on nearly all fission products, a large number of biologically important activation products, and various naturally occurring radioactive nuclides such as uranium and thorium. Subject, author, geographic location, taxon, and permuted title indexes are included. (CH)

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

00701 (LA-UR—75-1122) **Model cosmic gamma-ray burst.** Strong, I.B.; Klebesadel, R.W.; Evans, W.D. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 4p. (CONF-750805—7). Dep. NTIS $4.00.

From 14. international cosmic ray conference; Munich, F.R. Germany (15 Aug 1975).

Observational facts relating to cosmic gamma-ray bursts are briefly summarized and classified into two rough categories: (1) well-established facts and (2) less-well-established facts. Most of the models proposed to explain the phenomena of cosmic gamma-ray bursts are found to be in conflict with the first category and only a few classes of explanation are compatible with both. (BJG)

00702 (LA-UR—75-1123) **Gamma-ray bursts from black hole accretion disks.** Strong, I.B. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 7p. (CONF-750805—1). Dep. NTIS $4.00.

From 14. international cosmic ray conference; Munich, F.R. Germany (15 Aug 1975).

The suggestion was first made more than a year ago that gamma-ray bursts might originate in the neighborhood of black holes, based on some rather circumstantial evidence linking Cygnus X-1, the prime black-hole candidate, with two of the then-known gamma-ray bursts. Since then additional evidence makes the idea still more plausible. The evidence is summarized briefly, a physical model for production of gamma-ray bursts is given, and several of the more interesting consequences of such an origin are pointed out. (auth)

STARS

00703 (COO—3071-113) **Neutrino astrophysics.** Bludman, S.A. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 17 Jan 1975. 36p. (CONF-741215—3; UPR—0036T). Dep. NTIS $5.00.

From 7. Texas symposium on relativistic astrophysics; Dallas, Texas, USA (16 Dec 1974).

Neutrino or antineutrino emission from collapsing or bouncing stars is considered. Up to 10^{15} GM CCM^{-3}, a hot neutron fluid behaves like an ideal gas and the neutron—proton ratio is generally less than that of a cold neutron star. The neutrino diffusion approximation is expected to be valid down to E/sub upsilon/ = 8 MeV, but the Fermi statistics and the energy dependence of weak cross-sections lead to important differences between photon- and neutrino-emitting stars. From the energy release in collapse of a degenerate core to neutron star radius and the dynamics of free-fall, a period T approximately 1 ns and pulse width ΔT greater than 14 μs is expected. The dynamics of rich clusters of galaxies is

discussed. It is shown that the cluster missing mass cannot be attached to massive superhalos about the galaxies but must be in intergalactic objects of lower mass. (BJG)

00704 (LA-UR—75-1038) **Particle acceleration near an accreting black hole.** Ames, S. (Los Alamos Scientific Lab., N.Mex. (USA)). Aug 1975. Contract W-7405-ENG-36. 5p. (CONF-750805—6). Dep. NTIS $4.00.

From 14. international cosmic ray conference; Munich, F.R. Germany (15 Aug 1975).

An electrically charged, rotating black hole can polarize the surrounding vacuum, leading to the creation of 10^{20}- to 10^{21}—eV electrons and positrons. The particles are produced in short bursts in time. The spectrum of particles produced by this process and their angular distribution are calculated, and the time behavior of some models is discussed. (3 figures) (auth)

00705 (N—74-21440, pp 393-403) **Mechanism for the abundance enhancements of heavy nuclei in solar flare particle events.** Cartwright, B.G.; Mogro-Campero, A. (Univ. of Chicago). 1972.

From Proceedings on high energy phenomena on the sun; Greenbelt, Maryland, USA (28 Sep 1972).

High energy phenomena on the sun.

A mechanism is proposed to account for the recently reported abundance enhancements of heavy nuclei in solar flares. The mechanism requires two acceleration stages for its operation: First, fully stripped ions are accelerated to suprathermal energies, and subsequently, a fraction of these ions are Fermi-accelerated to higher energies. It is shown that because injection into Fermi-acceleration is rigidity-dependent and the ions may pick up electrons during transport to the Fermi-acceleration region, an enhancement of the abundances of heavy nuclei can occur. The degree of the enhancement depends on a number of factors particular to each flare, so that the degree of enhancement may be variable from flare to flare, or may be a function of time within a given flare. In some flares, conditions may be such that no enhancement would be expected. (auth)

00706 (N—74-21440, pp 427-438) **Solar flare alpha particles.** Lanzerotti, L.J. 1972.

From Proceedings on high energy phenomena on the sun; Greenbelt, Maryland, USA (28 Sep 1972).

High energy phenomena on the sun.

Interplanetary disturbances frequently change the instantaneous values of the low-energy solar flare alpha-to-proton flux ratios (when particles are compared as to equal energy per nucleon). The fluxes of alpha particles (approximately 1 to approximately 12 MeV/nucleon in five differential channels) have been integrated over the duration of seven large solar events occurring between May 28, 1967, and November 6, 1969, in order to investigate the total alpha particle fluxes observed at 1 AU resulting from the flares. The spectra of the event-integrated alphas are always softer than the spectra of the event-integrated protons. As a consequence, the event-integrated alpha-to-proton ratios decrease slightly with increasing energy per nucleon. The $^4He/^1He$ ratios averaged over the seven events are found to vary as 0.026 $(E/nucl)^{-0.2}$ b_0 in the range 1 to 10 MeV/nucleon. The value of the ratio at 1 MeV/Nucleon is less than the helium-to-hydrogen abundance determined from spectroscopic studies of prominences and the chromosphere (approximately 0.06), and is less than the average solar wind helium-to-hydrogen abundance (approximately 0.045). (auth)

COSMOLOGY

00707 (N—73-28753, pp vp Paper 15) **Deuterium puzzle in the symmetric universe.** Leroy, B.; Nicolle, J.P.; Schatzman, E. (Observatoire, Meudon, France). Jun 1973.

From NASA international symposium and workshop on gamma ray astrophysics; Greenbelt, Maryland, USA (20 Apr 1973).

International symposium and workshop on gamma-ray astrophysics.

The examinations of the experimental data concerning the reaction anti p + ^{4}He yields pions + nuclei shows that the low abundance of ^{2}D can be explained only by assuming a low He abundance at the beginning of the radiative era. This is a completely independent confirmation of the evasion of neutrons (and antineutrons) from the emulsion before the end of the epoch where nucleogenesis might have taken place, and leads to an estimate of the size of the emulsion when T = 1 MeV, L approximately $0.10^{4.8}$ cm. (auth)

PLANETARY PHENOMENA

00708 (COO—2195-12) **Density variations in the lower thermosphere. Scientific report No. 2.** Johnson, W.F. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Meteorology). 19 Feb 1974. Contract AT(11-1)-2195. 175p. Dep. NTIS $11.75.

Thesis.

Accelerometer derived thermospheric density data from the LOGACS and SPADES satellites are processed to yield the equivalent density variation at 150 and 160 km respectively. Definite latitudinal and longitudinal variations are found which conflict with Jacchia's 1971 model. Time-latitude analyses are presented of density at a single altitude. The density response to a great geomagnetic storm is nearly the same from 25°S to 85°N except that a density trough forms just equatorward of the auroral oval. Gravity waves are observed during the storm. The structure and dynamics of the lower thermosphere are far more complex than previous studies indicate. (20 figures, 11 tables, 74 references) (auth)

00709 (UCRL—76755) **New model for the lunar interior to 250 km.** Piwinskii, A.J.; Duba, A.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 May 1975. 24p. (CONF-750344—1). Dep. NTIS $4.00.

From 6. lunar science conference; Houston, Texas, USA (17 Mar 1975).

A new model for the structure of the lunar interior to about a 250-km depth is proposed. It is suggested that this region is composed of plagioclase-bearing rocks, and that the 65-km seismic discontinuity represents the appearance of garnet. A variety of rock types mainly composed of plagioclase, pyroxene, olivine and garnet is envisioned, with at least half of the outer 250 km of the moon made of plagioclase, which dominates the electrical conductivity. This model agrees with recent petrological and electrical conductivity results and does not violate velocity-depth profiles obtained from elastic-wave studies of lunar and terrestrial materials. (auth)

ATMOSPHERIC PHYSICS

MAGNETOSPHERIC PHENOMENA

00710 (LA-UR—75-791) **Recent observations relating to the dynamics and origin of the magnetotail plasma sheet.** Hones, E.W. Jr. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 28p. (CONF-750461—1). Dep. NTIS $4.50.

From The nobel symposium on the physics of the hot plasma in the magnetosphere; Kiruna, Sweden (2 Apr 1975).

This paper reviews the substorm behavior of the plasma sheet and the evidence that a substorm expansive phase onset signals the sudden formation of a magnetic neutral line across a near region of the magnetotail. The neutral line forms at distances less than approximately 18 R/sub E/ in moderate to intense substorms, but at distances greater than approximately 30 R/sub E/ in weak substorms, or substorms detected only at high latitudes (on the contracted auroral oval). Several types of observations are presented as evidence that solar wind plasma enters the plasma sheet via convection along the cleft, through the magnetotail surface layer, through the magnetotail lobes and finally earthward from a magnetotail neutral line. These observations were made, however, during periods of southward interplanetary magnetic field; possibly this is a less effectual route for plasma entry to the plasma sheet when the IMF is northward. (auth)

00711 (ORNL—5025, pp 147-148) **Radiative electron capture.** Biggerstaff, J.A.; Appleton, B.R.; Datz, S.; Moak, C.D.; Neelavathi, V.N.; Noggle, T.S.; Ritchie, R.H.; VerBeek, H. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Some data are presented for radiative electron capture by fast moving ions. The radiative electron capture spectrum is shown for O^{8+} in Ag, along with the energy dependence of the capture cross-section. A discrepancy between earlier data, theoretical prediction, and the present data is pointed out. (3 figs) (GMT)

00712 (UCRL—76299) **Advances in magnetospheric physics, 1971—1974: energetic particles.** West, H.I. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1974. 73p. (CONF-750821—1). Dep. NTIS $6.75.

From American geophysical union meeting; Grenoble, France (24 Aug 1975).

An account is given of energetic particle research in magnetospheric physics for the time period 1971—1974. Emphasis is on relating the various aspects of energetic particles to magnetospheric processes. 458 refs. (auth)

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

BEAMS AND THEIR REACTIONS

00713 (ORNL—5025, pp 148-149) **Stopping power of channeled iodine ions at low velocities.** Biggerstaff, J.A.; Appleton, B.R.; Brown, M.D.; Datz, S.; Moak, C.D.; Noggle, T.S.; VerBeek, H. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The results of some recent measurements of the specific energy loss of 0.6- to 60.0-MeV iodine ions in the (111) planar channel of a silver crystal are shown. (1 fig) (GHT)

ATOMIC AND MOLECULAR PROPERTIES

00714 (ANL—8153, pp 150-160) **Theoretical chemistry.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Work in theoretical chemistry was organized under the following topics: scattering theory and dynamics (elastic scattering of the rare gas hydrides, inelastic scattering in Li + H_2, statistical theory for bimolecular collisions, model study of dissociative scattering, comparative study of elastic scattering computational methods), studies of atmospheric diatomic and triatomic species, structure and spectra of diatomic molecules, the evaluation of van der Waals forces, potential energy surfaces and structure and dynamics, calculation of molecular polarizabilities, and development of theoretical techniques and computing systems. Spectroscopic parameters are tabulated for NO_2, N_2O, H_2O^+, VH, and NH. Self-consistent-field wave functions were computed for He_2 in two-center and three-center bases. Rare gas hydride intermolecular potentials are shown. (9 figures, 14 tables) (RWR)

00715 (COO—2130-163, pp 329-351) **Metastable atomic states of heavy ions. I. X-ray emitting states.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

Elementary systems of metastable atomic states of heavy ions are discussed, placing emphasis on analogs of hydrogen, helium, and lithium with extensions to heavier two electron systems such as oxygen and fluorine. Multipole radiations are considered and experimental arrangements for measuring lifetimes of excited states are examined. (16 figures) (SDF)

00716 (COO—2130-163, pp 352-379) **Metastable atomic states of heavy ions. II. X-ray and Auger emitting states.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

Metastable atomic states of heavy ions are discussed. Topics include autoionization, Auger processes, and systems with three electrons. (24 figures) (SDF)

00717 (COO—2130-163, pp 380-414) **Metastable atomic states of heavy ions. III. Auger emitting states and astrophysical topics.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

Autoionization of metastable atomic states of heavy ions is discussed and systems with more than three electrons are briefly considered. The natural occurrence of metastable ions is examined. (2 tables, 33 figures) (SDF)

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

00718 (COO—3496-50, pp 81-90) **Muon lifetime measurements in the actinide elements.** Hensley, W.K. (Los Alamos Scientific Lab., NM); Huizenga, J.R.; Perry, D.G.; Browne, J.C.; Kalbach, C. 1975.

Studies of nuclear fission, low energy nuclear reactions and transuranic nuclei. Progress report, 1 June 1974—1 June 1975.

00719 (LA—5994-MS) **Hadronic atoms and ticklish nuclei: the E2 nuclear resonance effect.** Leon, M. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1975. 9p. Dep. NTIS $4.00.

The E2 nuclear resonance effect in hadronic atoms offers a way to increase the hadronic information that can be obtained from hadronic x-ray experiments. The effect occurs when an atomic deexcitation energy closely matches a nuclear excitation energy, so that some configuration mixing occurs. It shows up as an attenuation of some of the hadronic x-ray lines from a resonant versus a normal isotope target. The effect was observed very clearly in pionic cadmium in a recent LAMPF experiment. A planned LAMPF experiment will use the nuclear resonance effect to determine whether the p-wave π-nucleus interaction does indeed become repulsive for Z greater than or equal to 35 as predicted. The effect also appears in the kaonic molybdenum data taken at LBL because several of the stable molybdenum isotopes are resonant. A number of promising cases for π^-, K^-, anti p, and Σ^- atoms are discussed and a spectacular and potentially very informative experiment on anti p-^{100}Mo is proposed. (9 figures, 9 tables) (auth)

00720 (LBL—3857) **Measurements of x-rays and γ-rays from stopped kaons.** Godfrey, G.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 9 May 1975. Contract W-7405-ENG-48. 114p. Dep. NTIS $8.75.

Thesis.

Intensities of x rays and γ rays from negative kaons stopped in elements, pure isotopes, and some compounds ranging from Z = 2 through Z = 92 have been measured. Included were x rays from K^- atoms, Σ^- atoms, and π^- atoms. Also some nuclear γ rays associated with the stopped kaons were observed. The kaonic x-ray intensities for low n, $\Delta n = 1$ transitions, varied from .1 to .5 x rays/K/sub stop/ and showed a remarkable oscillation as Z changed. Peaks occurred near elements with closed electron shells. Within experimental accuracy, isotopes of the same elements yielded equal intensities. By searching for μ^- from K^- yields μ^- anti ν it was concluded that less than or equal to 5 percent of the stopped kaons decayed before nuclear capture in those elements studied. A cascade calculation was performed that reasonably reproduced the $\Delta n = 1$ intensities but gave $\Delta n = 2$ intensities high by a factor of 2. Initial kaon distributions in n = 30 proportional to (2l + 1) out to some l/sub max/ were used to begin the cascade. The value of l/sub max/ changed with Z. It is suggested that l/sub max/ might be related to an impact parameter picture with the lever arm equal to one-half the distance between the atoms in their lattice. (auth)

COLLISION PHENOMENA

00721 (ANL—8153, pp 62-69) **Molecular-beam studies.** Wexler, S.; Parks, E.K.; Young, C.E.; Dehmer, P.M.; Kuhry, J.G.; Cohen, R.B.; Pobo, L.G. Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Highlights of experimental results obtained with chemical accelerators are described under the following headings: development of an aerodynamic source of fast I atoms and I_2 molecules; chemi-ionization processes in collisions of uranium atoms with oxygen molecules; chemi-ionization reactions in other metal—O_2 collisions (La, Ce, Th); kinetic surface ionization; and single-crystal beam source. Relative cross sections for formation of various collision products are shown, as a function of energy in the eV range. (12 figures) (RWR)

00722 (CONF-750705—3) **Basic aspects of secondary electron distributions.** Kim, Y.K. (Argonne National Lab., Ill. (USA)). Jul 1975. Contract W-31-109-Eng-38. 15p. Dep. NTIS $4.00.

From 9. international conference on physics of electronic and atomic collisions; Seattle, Washington, USA (24 Jul 1975).

Graphical methods proposed by Platzman and by Fano are applied to the analysis of the basic features observed in secondary electron spectra. These methods are useful not only in checking the consistency of experimental data, but also in extrapolating the spectra to the range of primary- and secondary-electron energies not covered by experiments. Illustrative examples are presented for He, Ne, and NO. (auth)

00723 (COO—2130-163, pp 171-187) **Homonuclear quasimolecule picture for ion—atom collisions.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

Low energy ion-atom collisions are described by building quasimolecules from the collision partners. Reference is made to correlation diagrams and vacancy production. Calculations of Briggs and Macek are outlined for production of inner shell vacancies in neon$^+$-neon collisions. The extraction of cross sections is also examined. (SDF)

00724 (COO—2130-163, pp 188-207) **Diabatic models and spectral features.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

The use of correlation diagrams for explaining gross phenomena is discussed. Diabatic models of ion-atom collisions are considered and characteristic spectral features are analyzed. (SDF)

00725 (ORNL—5025, pp 138-146) **Atomic structure and collision experiments.** Sellin, I.A.; Brown, M.D.; Forester, J.P. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The lifetimes of the metastable (1s2s2p)^{4}p/sub 5/2/^{o} state in ions of the lithium sequence have been measured for Al^{10+}, Si^{11+},

S^{12+}, as an extension of earlier measurements for O^{5+}, F^{6+}, Cl^{11+}, and Ar^{13+}. Comparison is made with autoionization and M2 rate calculations for this state in ions from Z = 3 to 26. Beam foil spectroscopy was used to obtain spectra of one-, two-, three-, four-, and five-electron oxygen and fluorine in the wavelength region 70 to 200 A. A typical spectrum is shown. Studies of noncharacteristic x-ray emission from heavy ion collisions are presented for Al-Al, Si-Al, GC, O-C, and Ni-Ni. Examples of electron spectra resulting from Li^+ and Na^+ collisions with a helium target are shown, and the advantage of alkali beams over alkali targets is pointed out. Measurements of the charge states of ions in dense media by applying the charge-state dependence of K x-ray production in gases are described, and results of high resolution studies of x-rays from impact of high charge-state energetic heavy ions on gases are reported. (8 figures) (GHT)

00726 (ORO—4325-13, pp 5-18) **L-shell ionization of intermediate- and high-Z elements by alpha particles.** Hardt, T.L.; Watson, R.L. 1975.

Ionization phenomena. Progress report, 1 December 1974—31 July 1975.

00727 (ORO—4325-13, pp 18-27) **Program ORION.** Hardt, T.L. 1975.

Ionization phenomena. Progress report, 1 December 1974—31 July 1975.

00728 (ORO—4325-13, pp 32-36) **L-vacancy lifetime effects on Kα x-ray satellites produced in heavy-ion—atom collisions.** Watson, R.L.; Chiao, T.; Jenson, F.E.; Sonobe, B.I. 1975.

Ionization phenomena. Progress report, 1 December 1974—31 July 1975.

00729 (ORO—4325-13, pp 36-42) **Systematics of single K-plus multiple L-shell ionization in heavy-ion—atom collisions.** Watson, R.L; Chiao, T.; Jenson, F.E.; Sonobe, B.I. 1975.

Ionization phenomena. Progress report, 1 December 1974—31 July 1975.

00730 (UCRL—51889) **Application of nonlinear optical techniques for the investigation of molecular properties and collisional processes.** Bischel, W.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1975. Contract W-7405-Eng-48. 295p. Dep. NTIS $7.60.

Thesis.

Molecular collisional processes were studied by using two different nonlinear optical techniques utilizing CO_2 lasers. The first study used the techniques of saturation spectroscopy to study the momentum transfer in one direction which occurs when CO_2 collides with itself, H_2, Ne, NH_3, and CH_3F. Average CO_2 velocity changes determined from these experiments were typically $^1/_{10}$ the thermal velocity or less. A theoretical model was also developed to explain the experimental observations of CO_2 with foreign gas perturbers. Generally good agreement between this model and the data was obtained. The second technique utilized the high-resolution capabilities of Doppler-free two-photon absorption (DFTPA) for the study of molecular properties and collisional processes in the two molecules CH_3F and NH_3. The first observation of DFTPA in molecular systems using two fixed-frequency CO_2 optical fields in combination with molecular Stark tuning is reported. The pressure broadening coefficient and the pressure shift of the O yields ν_3 transition were measured; broadening coefficients for the foreign gas perturbers of He and CF_3I were determined. A self-broadening coefficient of the O yields $2\nu_3$ transition was also measured; foreign gas broadening coefficients for the collision partners H_2, D_2, He, Ne, and Xe were determined. Spectroscopic information was also obtained about these two molecular systems. (62 figures, 33 tables, 182 references) (RWR)

ATOMIC AND MOLECULAR THEORY

00731 (LBL—3647) **Nonperturbative theory of single/multiphoton processes in atoms and molecules induced by intense laser fields.** Lau, A.M.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1975. Contract W-7405-ENG-48. 58p. Dep. NTIS $6.00.

Thesis.

A quantum nonperturbative theory is given for the problem of a general n discrete-level atomic/molecular system interacting with a strong single-mode/multimode radiation field. The atomic/molecular energy-level structures are modified due to interaction with the laser field. These energy level shifts are derived in the rigorous solution to the adiabatic eigenvalue problem of the charge—field system, involving a simple iterative procedure. The task of solution is simplified by recurrence relations between matrices connecting probability amplitudes of successive photon numbers. New formulae for calculating probability of single/multiphoton transitions between three resonant shifted levels and between some cases of two near-resonant shifted levels are derived. This general formalism can be applied to calculate transition probabilities of various atomic/molecular photo processes of interest. Numerical values are obtained for the inelastic cross section of the slow-collisional process Li + H and for dissociation cross section of LiH molecule. The transition probabilities of Na (3s yields 5s by absorption of two photon of lambda = 0.60233μ — 0.602396 μ) and of Li (2s yields 3s by absorption of eight photons of lambda = 2.9406 μ — 2.945 μ) irradiated by a strong pulse are calculated. Finally, a parametric study is carried out for the process where a molecular system is interacting with two intense radiation fields of different wavelengths. Owing to potential barrier shift due to the much more intense field, the molecular system penetrates into an otherwise inaccessible region in the potential level where it is allowed to radiate to a lower level by emitting photons at a second wavelength. (12 figures, 6 tables) (auth)

FLUID PHYSICS

GENERAL FLUID DYNAMICS

00732 (COO—2456—11) **Physical and numerical dissipation and dispersion in viscous compressible flow computation.** Chu, C.K. (Columbia Univ., New York (USA)). 1975. Contract AT(11-1)-2456. 20p. (CONF-750352—1). Dep. NTIS $4.00.

From Symposium on unsteady aerodynamics; Tucson, Arizona, USA (18 Mar 1975).

A general view is given of the roles of numerical dissipation and numerical dispersion in finite difference schemes for unsteady fluid dynamics and for unsteady magnetohydrodynamics, and of the problem of differentiating these numerical properties from the physical properties. These questions are studied by means of simple model equations, rather than in terms of the full set of Navier—Stokes or magnetohydrodynamic equations, but the ideas and results are generalizable to the full equations relatively directly. In the treatment of steady flows as long-time limits of time-dependent flows, it is found that a comparatively inaccurate time-dependent scheme may produce an accurate steady state, and vice versa. (3 figures) (RWR)

SUPERFLUIDITY

00733 (ANL—8153, pp 123-126) **Fundamental studies on important liquids.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Phonon attenuation and velocity measurements in the range $\omega\tau > kt$ have been undertaken for ^3He, ^4He, and solutions. Specifically, anisotropic source propagation in superfluid ^3He and ultrasonic attenuation in liquid ^3He as a function of pressure from 35 to 500 MK are reported. (SDF)

00734 (BNL—20155) **Recent experiments on the surface of liquid ^{4}He: elastic scattering of ^{4}He atoms.** Edwards, D.O.; Fatouros, P.P.; Ihas, G.G.; Mrozinski, P.; Shen, S.Y.; Tam, C.P. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 19p. (CONF-750130—1). Dep. NTIS $4.00.

From International research workshop, and international symposium on quantum fluids; Sanibel, Florida, USA (26 Jan 1975).

The first part of the paper concerns the experimental determination of the two-dimensional effective interaction potential between ^{3}He atoms adsorbed on the surface of liquid ^{4}He. Measurements of the velocity of surface sound and of the surface tension indicate that, for concentrations of ^{3}He corresponding to a small fraction of a monolayer, the interaction is very weak and predominantly repulsive. This is unfavorable for a low-temperature superfluid condensation. The bulk of the paper discusses the implications of a recent experiment on the elastic scattering of free ^{4}He atoms pure liquid ^{4}He. The elastic scattering probability R(k, theta) has been measured as a function of the momentum of the atom $hk/2\pi$ and of the angle of incidence theta. In addition the probability of inelastic scattering was found to be very small (less than 2×10^{-3}). With the simplifying assumption that the scattered atoms can be treated as distinguishable from those in the liquid it is found that R(k,theta) can liquid. The relation between the scattering data and the spectrum of atoms evaporated from the liquid at finite temperature is also discussed. (4 figures) (auth)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

00735 (COO—3130TA-322) **Progress report for a research program in theoretical high-energy physics.** Feldman, D. (Brown Univ., Providence, R.I. (USA). Dept. of Physics). 1 Jun 1975. 9p. Dep. NTIS $4.00.

Last year's research program dealt with a variety of topics including eikonal/multiplicity studies (elastic and inelastic distributions by a semi-classical method, Gribov calculus); analytic parametrization (total cross sections, real to imaginary ratios of forward amplitudes, charge-exchange processes); multiperipheral cluster models (pion-pole dominance); narrow-width particles (conventional hadronic model for psi(3.1) and psi(3.7), baryon—antibaryon resonances, decays of long-lived hadrons); neutrino-nucleon collisions (charmed particles, neutral-current processes); models for permanently bound quarks (scalar quarks in one dimension, meson decays, spin-$^1/_2$ colored quarks); spontaneous symmetry breaking (excitation of composite fields, non-abelian gauge theories); properties of model field theories (Nambu model, Luttinger model); functional techniques for many-body systems (multiparticle production, phase transitions); topics in general relativity; as well as other studies involving the strong, electromagnetic, and weak interactions of elementary particles. A list of publications is included. (auth)

00736 (UCR—34P107-170) **Annual report [on high energy physics].** Kernan, A.; Poe, R.T. (California Univ., Riverside (USA)). Jun 1975. Contract AT(04-3)34. 24p. Dep. NTIS $4.25.

Efforts were concentrated on streamer chamber studies of heavy-ion interactions at the Bevalac and studies of proton diffraction dissociation at the CERN ISR. After a general description of this work, the following programs are discussed individually: streamer chamber study of Ω and Ξ^* states; streamer chamber study of neutral mesons; high-energy heavy-ion physics (study of fragmentation characteristics of heavy-ion collision and exploratory study of central-collision phenomena); observation of double Pomeron exchange processes at ISR energies; reports at the 1974 PEP summer study (measurement of the total cross section for e^+e^- yields hadrons, search for new particles at PEP, two-photon annihilation processes at PEP); and diffractive excitation of the proton at ISR energies. (RWR)

ELECTROMAGNETIC INTERACTIONS

00737 (COO—1195-340) **Photoproduction at FNAL.** Wattenberg, A. (Illinois Univ., Urbana (USA). Dept. of Physics). May 1975. 13p. (CONF-750547—6). Dep. NTIS $4.00.

From 4. international symposium on nucleon-antinucleon interations; Syracuse, New York, USA (2 May 1975).

Difficulties in estimating rates for the photoproduction of A—anti A pairs are discussed first. Then the experimental measurements are taken up; the beam and spectrum, the detecting apparatus, the results on γ + Be yields X + psi($\mu\mu$), and some raw data on hadron production are considered. An approximate value of 1.0 mb was obtained for the total cross section of a psi particle on a nucleon. (9 figures) (RWR)

00738 (COO—1195-341) **High energy photoproduction of new massive particles.** O'Halloran, T.; Sarracino, J.; Wattenberg, A. (Illinois Univ., Urbana (USA)). May 1975. 14p. (CONF-750654—4). Dep. NTIS $4.00.

From High energy particle physics divisional conference of EPS; Palermo, Italy (23 Jun 1975).

A series of experiments studying the high-energy photoproduction of the narrow resonance at 3.1 GeV/c^2 is discussed. The beam and detecting apparatus are described, and then the results obtained on photoproduction of the new massive particles are presented. Mass spectra of $\mu^+\mu^-$ and e^+e^- pairs obtained from photons (from 300-GeV protons) on Be are shown, along with the cross section for psi(3.1) yields μ for a sample of clean events. (10 figures) (RWR)

00739 (COO—3069-327) **Hadron and photon production of J particles and the origin of J particles.** Ting, S.C.C. (Massachusetts Inst. of Tech., Cambridge (USA)). 1975. 47p. (CONF-750654—1; OSP—73622). Dep. NTIS $5.50.

From High energy particle physics divisional conference of EPS; Palermo, Italy (23 Jun 1975).

Discovery of the J particles (psi-3105 and psi-3695) is detailed. A few experiments on the production of J particles are described, emphasizing photoproduction of J's by photons and hadrons. Finally, current theoretical attempts at explaining their origin are outlined. (29 figures) (SDF)

00740 (TID—26967) **Study of photoproduction of vector mesons on deuterium by 5.5 GeV linearly polarized photons.** Gupta, V.P. (California Univ., Riverside (USA)). Dec 1974. 81p. Dep. NTIS $7.25.

Thesis.

The experimental results of a deuterium bubble chamber photoproduction study of half a million pictures at 5.5 GeV are presented. This experiment was performed using a monoenergetic and linearly polarized photon beam facility at SLAC. At 5.5 GeV the beam polarization is greater than 90 percent, and the average FWHM of the beam energy spectrum is 0.6 GeV. The reaction γd yields $\pi^+\pi^-$d was studied in detail. A clear sample of γd yields rho^{0}d channel was obtained, and using the rho^0 decay distribution in terms of an extended density matrix which includes correlation with the beam polarization, one could determine nine independent density matrix parameters. The study of rho^0 production and decay in the reaction channel γd yields rho^{0}d was found to proceed almost completely through natural parity exchanges; the contribution from unnatural parity exchanges being only (5.3 +- 4.5) percent for momentum transfer paralleltparallel less than or equal to 0.25 GeV^2. It was observed that the rho^0 production mechanism conserves s-channel cms helicity for paralleltparallel less than or equal to 0.15 GeV^2. After carrying out the fitting to the $\pi^+\pi^-$ mass distribution, one obtained for the rho^0 mass and width the values (766 +- 5) and (139 +- 11) MeV, respectively. The rho^0 production cross section in this channel was determined to be (9.1 +- 0.8) μb. The final states $\pi^+\pi^-\pi^0$d, K^+K^-d, $\pi^+\pi^+\pi^-\pi^-$d, and $\pi^+\pi^-\pi^-$pp were obtained for the production of ω, phi, rho', and A_1 mesons, respectively. However, due to insufficient statistics, no conclusive remarks could be made. (auth)

WEAK INTERACTIONS

00741 (CONF-750307—10) **Neutrino interactions with two muons in the final state.** Barish, B.C.; Bartlett, J.F.; Bodek, A. (California Inst. of Tech., Pasadena (USA); Fermi National Accelerator Lab., Batavia, Ill. (USA)). 9 Apr 1975. Contract AT(11-1)-68. 12p. Dep. NTIS $4.00.

From International colloquium of the CNRS on neutrino physics at high energy; Paris, France (18 Mar 1975).

Neutrino interactions with two muons in the final state have been observed in the Caltech-Fermilab neutrino experiment. At the approximately 1 percent level nutrino events are observed to have an "extra" muon. Calculations for the decays of π and K mesons in the hadron final state give numbers which make this mechanism for the signal unlikely. (7 figures, 1 table) (auth)

STRONG BARYON-INDUCED INTERACTIONS

00742 (ANL/HEP-CP—75-31) **Multiparticle processes: recent results from the FNAL 30-inch bubble chamber.** Musgrave, B. (Argonne National Lab., Ill. (USA)). 1975. 87p. (CONF-750659—1). Dep. NTIS $7.50.

From 4. international seminar on high energy physics problems, many-body processes; Dubna, USSR (Jun 1975).

Some recent results on inclusive resonance production, on multiplicity distributions and on diffractive processes from the 30-inch bubble chamber at FNAL are reviewed. (45 figures, 52 references) (auth)

00743 (CONF-750649—1) **Acceleration of polarized protons to multi-GeV energies and experiments with polarized protons from 2 to 6 GeV/c.** Ratner, L.G. (Argonne National Lab., Ill. (USA)). 1975. 51p. Dep. NTIS $5.75.

From Symposium on hadron physics at high energies; Liblice, Czechoslovakia (16 Jun 1975).

Work with polarized protons at the ANL Zero Gradient Synchrotron is reviewed. The 6 GeV/c beam has achieved 6 x 10^9 polarized protons per pulse with 73 percent polarization. After a few remarks about machine operation, most of the results obtained by use of this beam are presented. The following experiments are included: proton—proton total cross sections; two and three spin measurements (simultaneous measurement of 2 and 3 spin interactions; measurement of C/sub NN/ at 3, 4, 6 GeV/c; measurement of D/sub NN/, D/sub SS/, and H/sub NSP/ at 6 GeV/c; measurement of D/sub NN/ at 6 GeV/c); polarization measurements in nucleon—nucleon elastic scattering (small-angle polarization in elastic pp scattering; np and pp polarization at 2, 3, 4, 6 GeV/c); inelastic interactions (N^* and Δ production in the effective mass spectrometer); inclusive Λ production (effective mass spectrometer experiment; exposure in the 12-ft hydrogen bubble chamber); coherent polarized proton—^{4}He interactions; and parity tests. (26 figures) (RWR)

00744 (COO—1195-339) **Hadron production at 0.8 mrad by 300 GeV protons incident on a thick aluminum target.** Aubert, B.;

Benvenuti, A.; Cline, D. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Apr 1975. 3p. (CONF-750307—8). Dep. NTIS $4.00.

From International colloquium of the CNRS on neutrino physics at high energy; Paris, France (18 Mar 1975).

Hadron (π/sup +-/, K/sup +-/, p, anti p) production was measured by using the Fermilab muon beam as a double-bend spectrometer, with the addition of threshold Cherenkov counters for particle identification. The measurement was made at 0.8 mrad with 300-GeV protons incident on a thick aluminum target. (auth)

00745 (COO—3065-119) **Studies of neutron dissociation at Fermilab energies.** Ferbel, T. (Rochester Univ., N.Y. (USA). Dept. of Physics and Astronomy). 20 Jun 1975. Contract E(11-1)-3065. 34p. (CONF-750654—9). Dep. NTIS $4.75.

From High energy particle physics divisional conference of EPS; Palermo, Italy (23 Jun 1975).

The latest results obtained in a continuing investigation of neutron dissociation in ($p\pi^-$) systems in neutron—nucleus collisions between 50 and 300 GeV/c are summarized. The nuclear coherent dissociation data are discussed first; then new measurements of total cross sections of neutrons on nuclei in the Fermilab momentum range are presented; finally, neutron dissociation using a hydrogen target is considered, and the hydrogen data are compared with expectations from simple Deck models. A substantial correlation was observed between the mass and the t of the system produced. The spin structure of the $p\pi^-$ amplitudes at low mass was described surprisingly well by the simple Deck mechanism. The t-channel helicity amplitudes contained comparable contributions from flip and nonflip terms, and the states produced were not restricted to those expected on the basis of the Morrison rule. (19 figures, 2 tables) (RWR)

00746 (COO—3130TB-214) **Progress report of a research program in experimental high energy physics, 1 September 1974—31 August 1975.** Shapiro, A.M.; Lanou, R.E. Jr. (Brown Univ., Providence, R.I. (USA)). 1975. Contract E(11-1)-3130. 59p. Dep. NTIS $6.00.

An experimental program in strong interaction physics is carried out using bubble chamber-hybrid system and counter-spark chamber techniques. The experiments were and are being performed utilizing the accelerators of the National Laboratories at Argonne, Brookhaven, and Batavia. In 4.1-GeV/c π^+p interactions, the bubble chamber group is studying: π^+ and π^- inclusive distributions; two-particle correlations; two-body and quasi-two-body production mechanisms; and strange-particle production. A multiwire proportional hybrid system was brought into operation at FNAL. With it, aspects of 150-GeV/c π^-p, π^+p, and pp interactions are studied: total and partial cross sections; charged-particle multiplicity distributions and their moments; single-particle inclusive distributions and two-particle correlations; leading particle and diffraction phenomena; and production models for high multiplicity events. The experiments of the counter-spark chamber group include the following: a study of baryon exchange processes using backward pion charge exchange; a search for high mass boson resonances and the determination of their quantum numbers in antiproton-proton systems; a nucleon-nucleon and meson-nucleon elastic and quasi-elastic scattering experiment at the highest accelerator energies possible; protons, pions and kaons are used as projectiles and protons and neutrons as targets; the role of the pomeron and exchange models generally is investigated; and a measurement of the inclusive spectra of hadrons as a function of multiplicity at FNAL energies. (auth)

00747 (COO—3230-4) **Research in elementary particle physics. Technical progress report, 1 September 1974—29 May 1975.** Kirsch, L.E.; Schnitzer, H.J. (Brandeis Univ., Waltham, Mass. (USA). Dept. of Physics). 1975. Contract E(11-1)-3230. 15p. Dep. NTIS $4.00.

Experimental and theoretical research on strong interactions is summarized. A list of publications is included. (JFP)

00748 (LA-UR—75-1244) **Pion production in nucleon—nucleon collisions.** Stephenson, G.J. Jr. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 7p. (CONF-750631—5). Dep. NTIS $4.00.

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

The summary of research on pion production in nucleon—nucleon collisions is presented giving an idea of the quality of the data now becoming available. Attention is called to some regularities. (JFP)

00749 (LA-UR—75-1284) **Some topics concerning N—N and N—D experiments at medium energy.** Simmons, J.E. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. 24p. (CONF-750631—4). Dep. NTIS $4.25.

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

The status of recent proton-proton phase shift analyses is reviewed at medium energy with mention of the state of the n-p I = 0 analyses. Some conclusions are reached, including a recommendation for renewed theoretical effort to calculate absorption parameters for N—N scattering above 300 MeV in higher partial waves (l greater than or equal to 3). Recent experimental data are examined for p-p small angle scattering at 630 MeV and also near 500 MeV. Further small angle experiments on p-p and p-d scattering are deemed desirable. A brief discussion of recent n-p charge exchange experiments is given. Finally, the status of medium to high energy (100 to 2000 MeV) p-d elastic scattering is reviewed with emphasis on back angle scattering and the usefulness of p-d polarization measurements. (1 table, 12 figures, 94 references) (auth)

00750 (LBL—3636) **An experimental study of the reaction p + d yields ^{3}He + π^0 in the Δ(1236) resonance region.** Fredrickson, D.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1974. Contract W-7405-ENG-48. 99p. Dep. NTIS $8.00.

Thesis.

The differential cross section of the reaction p + d yields ^{3}He + π^0 was measured at an incident proton energy of 462 MeV for ^{3}He cm angles between 50 and 130°. Limited angular distributions were also obtained at 377 and 576 MeV. The ^{3}He particle momentum was measured by using wire spark chambers in conjunction with a total energy absorption scintillation counter. A decay photon from the π^0 was detected in a lead glass Cherenkov counter. The results are discussed in terms of a two-nucleon model and a OPE model of the reaction. The cross section at 462 MeV is also compared with that of its isospin conjugate reaction, p + d yields ^{3}H + π^+, and agreement with the principle of isospin invariance is satisfactory, except at small pion angles. (auth)

00751 (LBL—3859) **Pion production in nucleus—nucleus collisions.** Schroeder, L.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. Contract W-7405-ENG-48. 11p. (CONF-750631—12). Dep. NTIS $4.00.

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

Current work on pion production in high-energy nucleus-nucleus collisions is reviewed. The majority of existing data are of the inclusive variety in which a single final state pion is detected. Experimental data are compared and their possible contributions to obtaining new information on nuclear structure is discussed. Various models which attempt to explain the observed single-inclusive-pion spectra either on the basis of a nucleon-nucleus interaction in which Fermi motion is included or on some type of cooperative model are examined. Other areas of interest involving pion production include tests of charge symmetry and pion multiplicities. (9 figures, 1 table) (auth)

00752 (ORO—4449-6) **Study of the neutron—proton interaction in the 300 to 700 MeV energy region. Annual progress report, 1974—1975 .** Northcliffe, L.C. (Texas Agricultural and Mechanical Univ., College Station (USA). Research Foundation). 24 Jul 1975. Contract AT(40-1)-4449. 12p. Dep. NTIS $4.00.

During the past year the LAMPF user group from Texas A and M University worked with scientists from LASL, the University of Texas, and the University of New Mexico to study neutron producing reactions, the n—p differential cross section for charge-exchange scattering, meson production in nucleon—nucleon collisions, and spectra of charged particles produced in the bombardment of various targets by monoenergetic neutrons. This report encompasses personnel, experimental method and apparatus, and results. The research is discussed briefly, and reference is made to appropriate places in the literature where more details can be found. (RWR)

00753 (UCR—34PA107-196) **Preliminary results of charm search.** Baum, L.; Block, M.; Crawford, J.; Couchman, B.; Derevshchikov, A.; Golutvin, I.; Hilsher, H.; Irion, J.; Kernan, A.; Kukhtin, V.; Layter, J.; Marsh, W.; Muller, F.; McIntire, P.; Naroska, B.; Nussabaum, M.; Orkin-Lecourtois, A.; Rossi, L.; Rubbia, C.; Schinzel, D.; Shen, B.; Staude, A.; Tarnopolski, G.; Voss, R. (European Organization for Nuclear Research, Geneva (Switzerland)). 17 Apr 1975. 6p. Dep. NTIS $4.00.

The electron to pion ratio at 30° from pp collisions has been measured at the ISR (26 GeV on 26 GeV). Preliminary results are presented. (auth)

STRONG MESON-INDUCED INTERACTIONS

00754 (COO—1195-343) **Possible broad 3π resonance near 1900 MeV/c coupling to N anti Δ.** Rhines, D.S. (Illinois Univ., Ur-

bana (USA). Dept. of Physics). May 1975. 4p. (CONF-750547—5). Dep. NTIS $4.00.

From 4. international symposium on nucleon-antinucleon interations; Syracuse, New York, USA (2 May 1975).

Work on the possible existence of narrow enhancements (approximately 10 MeV or less) in the anti N—N total cross section near threshold was considered at this conference. Recently published data on the interaction π^-p yields p$\pi^+\pi^-\pi^-$ are shown; numbers of events are plotted vs m($\pi^+\pi^-\pi^-$). A broad enhancement was seen in the 1900-MeV region; a fit to a smooth background plus a Breit—Wigner enhancement gave M = 1895 +- 19 MeV/c² with a width of 123 +- 66 MeV/c². A few brief comments on the data are made. (3 figures) (RWR)

00755 (COO—1428-421, pp 20-32) **Counter-wire chamber experiments at ANL.** Garfinkel, A.F.; Loeffler, F.J.; Shibata, E.I.; Stanfield, K.C. 1975.

Annual progress report, June 1, 1974—May 31, 1975.

00756 (ORNL—5025, pp 81-82) **π^+ + d yields p + p at 40, 50, and 60 MeV.** Gross, E.E.; Ludemann, C.A.; Saltmarsh, M.J. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Angular distributions have been obtained for the π^+ + d yields p + p reaction at incident pion energies of 40, 50, and 60 MeV. Measurements were made over the angular range from 15 to 110 degrees with a statistical accuracy of 3 percent. (1 figure) (SDF)

00757 (ORNL—5025, pp 220-221) **π^--hydrogen at very high energies.** May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Experiments involving the interaction of 147 GeV/c π^- with hydrogen have been performed. Data was obtained at FNAL with the 30 inch bubble chamber and wire proportional counter hybrid system. Topological cross sections are given. (1 table) (SDF)

00758 (ORO—2504-236) **Remarks on the status of the Z_1*.** Steinberg, P.H. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jul 1975. 11p. Dep. NTIS $4.00.

Two developments which provide evidence for the existence of the Z_1* resonance are discussed. The first involves improved results for k⁺p elastic scattering differential cross sections. The second is an energy dependent partial wave analysis based on k matrix formalism. Other supporting evidence is briefly considered. (3 figures) (SDF)

00759 (TID—26968) **Decay of A_2^0 in the streamer chamber.** Ozawa, J.T. (California Univ., Riverside (USA)). Jun 1975. 132p. Dep. NTIS $9.75.

Thesis.

The neutral A_2^0 meson was studied in the reaction π^-p yields A_2^0n at 3.2 GeV/c. Using the missing mass technique, the neutron triggered the streamer chamber at Lawrence Berkeley Laboratory to detect the decay products of A_2^0. The neutrons were detected by a neutron spectrometer system consisting of 30 scintillation counters in the Jacobian peak area and 20 scintillation counters in the forward direction. A result consistent with the no splitting of A_2^0 (1320) is found. (auth)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

WEAK INTERACTIONS

00760 (CONF-750307—9) **Investigations of the structure of the neutral current coupling in inclusive neutrino interactions.** Barish, B.C.; Bartlett, J.F.; Bodek, A. (California Inst. of Tech., Pasadena (USA); Fermi National Accelerator Lab., Batavia, Ill. (USA)). 9 Apr 1975. Contract AT(11-1)-68. 14p. Dep. NTIS $4.00.

From International colloquium of the CNRS on neutrino physics at high energy; Paris, France (18 Mar 1975).

Preliminary results from a neutral current experiment performed in the Fermilab narrow band neutrino beam are presented. The hadron energy distributions obtained from high energy neutral current interactions in both neutrino and antineutrino beams are presented, and are used to infer constraints on the possible kinds of neutral current coupling. Strongly dominant scalar and pseudoscalar couplings are not consistent with the distributions observed, nor is a dominant V + A coupling. Very preliminary studies show no inconsistency with some combination of V + A and V - A couplings. (auth)

00761 (LBL—4207) **Negative muon spin rotation experiment.** Yamazaki, T.; Nagamine, K.; Nagamiya, S.; Hashimoto, O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. Contract W-7405-ENG-48. 12p. (CONF-750631—9). Dep. NTIS $4.00.

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

Results of the experimental project using negative muon spin rotation at Lawrence Berkeley Laboratory are reported. The following were discussed briefly: the bound muon g factors from the viewpoints of the relativistic and nuclear polarization effects, strange depolarization phenomena in terms of the difference between the muonic-atom probe and its equivalent nuclear probe, application of the μ^- 0 probe to studies of magnetic oxides, and total muon capture rates in the actinide region. (auth)

00762 (UH—511-197-75) **Space time structure of neutral current.** Pakvasa, S. (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). Jun 1975. Contract AT(04-3)-511. 8p. Dep. NTIS $4.00.

Some work on the general phenomenological analysis of the inclusive process ν(anti ν) + N yields nu anti ν) + anything taking all the covariants V, A, S, P, and T into account is presented. (JFP)

STRONG INTERACTIONS, GENERAL

00763 (COO—3075-70) **Color quarks and octonions.** Guersey, F. (Yale Univ., New Haven, Conn. (USA). Dept. of Physics). 1974. Contract AT(11-1)-3075. 29p. (CONF-740135—2). Dep. NTIS $4.50.

From John Hopkins workshop on current problems in high energy particle theory; Baltimore, Maryland, USA (18 Jan 1974).

A mathematical framework based on octonions is developed for the description of the color quark scheme in which quarks are unobservable, the color SU(3) is exact, and only color singlets correspond to observable hadrons. The fictitious Hilbert space in which quarks operate is taken to be a space of vectors with octonion components. This space admits as a gauge group an exact SU(3) identified with the color SU/sub C/(3). Because of the nonassociativity of the underlying algebra, nonsinglet representations of SU/sub C/(3) are unobservable, while the subspace of color singlets satisfies associativity along with conditions for observability. Octonion quark fields satisfy the commutation relations of parafermions of order 3, leading to the correct SU(6) multiplets for hadrons. (auth)

00764 (COO—3533-54) **Strings, monopoles, and meson states.** Balachandran, A.P.; Ramachandran, R.; Schechter, J.; Wali, K.C.; Rupertsberger, H. (Syracuse Univ., N.Y. (USA). Dept. of Physics; Vienna Univ. (Austria). Inst. fuer Theoretische Physik). Apr 1975. 24p. (SU—4206-54). Dep. NTIS $4.25.

Dirac's formulation of the monopole theory modified by an additional mass term for the gauge field has been considered as a possible simplified model for quark binding. Methods are discussed for the consistent regularization of the infinities present in the resulting action and equations of motion. This leads to an action which is the same as that suggested by previous authors. It is shown that the expression for the energy of the modified action still has infinities unless the mass of the gauge field is infinite. Thus the regularization procedure is incomplete when the gauge field has finite mass. Applications of the regularized model to charmonium and other meson states are discussed. (auth)

STRONG INTERACTIONS, BARYON NO. 0

00765 (COO—3130TA-321) **Comments and critique of the Ω anti Ω model for the new resonances.** Tow, D.M. (Brown Univ., Providence, R.I. (USA). Dept. of Physics). 1975. Contract E(11-1)-3130. 11p. (CONF-750547—9). Dep. NTIS $4.00.

From 4. international symposium on nucleon-antinucleon interations; Syracuse, New York, USA (2 May 1975).

The suggestion that the psi particles are Ω anti Ω compounds is briefly reviewed. Various arguments for their small widths are discussed. Crucial tests of the model are pointed out. Also comments are made on psi'' (4.15) and other B anti B systems. (auth)

STRONG INTERACTIONS, BARYON NO. 1

00766 (COO—3130-TB-188) **Radiative corrections to Expt. 416. Backward πN charge exchange. Internal report No. 131.** Chen, G.T.Y. (Brown Univ., Providence, R.I. (USA). Dept. of Physics). [nd]. Contract AT(11-1)-3130. 54p. Dep. NTIS $5.75.

The importance of radiative corrections in elastic hadronic reactions has been reported recently. This report describes the

computational techniques and results of applying the radiative corrections to a backward charge-exchange scattering experiment. The particular reaction considered is $\pi^- p$ yields $\pi^0 + n + \gamma$ Evaluation of the Schwinger term, evaluation of the numerical integration term, evaluation of the region in which the photon is detected and a check of the unitarity condition are considered. Appendixes contain listings of computer codes written to calculate radiative corrections. (19 figures, 2 tables) (RWR)

00767 (LBL—3810) **Search for Ericson fluctuations in $\pi^+ p$ scattering at 3.7 and 7.1 GeV/c.** Michael, W.; Gidal, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1975. Contract W-7405-ENG-48. 13p. (CONF-750723—11). Dep. NTIS $4.00.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

Data on $\pi^+ p$ elastic scattering, obtained from two high-statistics bubble chamber exposures at 3.7 and 7.1 GeV/c beam momentum, were examined for Ericson fluctuations. No evidence for such fluctuations was found. It is shown that fixed-u features of the differential cross section will lead to nonzero values of the asymmetry parameter at fixed-t. (11 figures) (auth)

00768 (ORO—4856-8) **Invariant potential for elastic pion—nucleus scattering. Technical report No. 75-075.** Cammarata, J.B.; Banerjee, M.K. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Apr 1975. 51p. Dep. NTIS $5.75.

From the Wick-Dyson expansion of the exact propagator of a pion in the presence of a nucleus an invariant potential for crossing symmetric, elastic pion-nucleus scattering is obtained in terms of a series of pion-nucleon diagrams. The Chew-Low theory is used to develop a model in which the most important class of diagrams is effectively summed. Included in this model is the Exclusion Principle restriction on the pion-bound nucleon interaction, the effects of the binding of nucleons, a kinematic transformation of energy from the lab to the πN center of mass frames, and the Fermi motion and recoil of the target nucleons. From a numerical study of the effects of these processes on the π-^{12}C total cross section, the relative importance of each is determined. Other processes contributing to the elastic scattering of pions not included in the present model are also discussed. (9 figures) (auth)

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

00769 (COO—2232A-23) **High energy pd yields Xd diffraction dissociation: comparison to pp yields Xp and analysis.** Goulianos, K. (Rockefeller Univ., New York (USA)). 1975. Contract E(11-1)-2232A. 15p. (CONF-750654—2). Dep. NTIS $4.00.

From High energy particle physics divisional conference of EPS; Palermo, Italy (23 Jun 1975).

Cross sections for the reaction pp yields Xp in the diffraction dissociation region extracted from the recently reported precise Fermilab data on pd yields Xd are compared with results from Fermilab and ISR. The M/sub X/^{2}, t, and s dependence are discussed, and the first-moment finite mass sum rule is tested. (6 figures) (auth)

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

00770 (ORO—3992-183) **Poincare group, SU(3) and V-A in leptonic decay.** Boehm, A. (Texas Univ., Austin (USA). Center for Particle Theory). Jul 1975. Contract AT(40-1)-3992. 56p. Dep. NTIS $6.00.

From as few assumptions as possible about the relations between the Poincare group, the particle classifying SU(3) and V-A we derive properties of the K/sub l_3/ and K/sub L_2/ decays. From the assumed relation between SU(3) and the Poincare group and the first class condition it follows that the formfactor ratio Xi of K/sub l_3/ decay is Xi = −0.57, and that a value of Xi = 0 is in disagreement with very general and well accepted theoretical assumptions. Assuming universality of V-A, the Cabibbo suppression is derived from the relations between SU(3) and V-A as a consequence of the brokenness of SU(3). (auth)

APPLICATIONS TO STRONG INTERACTIONS

00771 (LA-UR—75-1281) **Implications of parity violating effects in strangeness conserving nonleptonic processes.** Herczeg, P. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. vp. (CONF-750631—8). Dep. NTIS $4.00.

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

Evidence for parity violation in nonleptonic nuclear processes began to accumulate about a decade ago. This paper discusses the information obtainable from the various experimental results regarding the question of the origin of these effects, and reviews some theoretical ideas which have recently been discussed in this connection. Reference is made to the α decay of the 8.88-MeV level of ^{16}O, the circular polarization in the capture of unpolarized thermal neutrons by protons, and the asymmetry in ^{19}F γ decay. Exchange-current contributions, parity violation in the electromagnetic interactions, large isotensor parity-violating forces, and isotensor axial vector electromagnetic currents are considered. (RWR)

FIELD THEORY

00772 (COO—2130-163, pp 272-304) **Quantum electrodynamic effects for light and heavy nuclei.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

The autoionization of positrons and the problem of vacuum polarization are discussed within the framework of quantum field theory. Various possible heavy ion experiments to check on the nonlinearity of electrodynamics are described. (8 figures) (SDF)

00773 (COO—2271-50) **Possible new form of matter at high density.** Lee, T.D. (Columbia Univ., New York (USA)). 1974. 23p. (CONF-741164—1). Dep. NTIS $4.25.

From Nucleon workshop; Bear Mountain, New York, USA (30 Nov 1974).

Investigation of the structure of the vacuum suggests the possibilities of vacuum excitation states, abnormal nuclear states and a new form of matter at high density. A mathematical presentation of vacuum excitation states and abnormal nuclear states is given. A discussion of the production and detection of the abnormal nuclear state is included. Future study should involve the distribution of high energy or high nucleon density over a relatively large volume to investigate some " lk" phenomena. (BJG)

00774 (COO—3075-63) **Free field theory of strings.** Ramond, P. (Yale Univ., New Haven, Conn. (USA). Dept. of Physics). 1974. 29p. (CONF-740135—1). Dep. NTIS $4.50.

From John Hopkins workshop on current problems in high energy particle theory; Baltimore, Maryland, USA (18 Jan 1974).

The quantum field theory of extended objects is developed considering only free fields and emphasizing an understanding of the classical field theory. A general overview of the requirements which must be met by the field is given, and it is shown that relativistic invariance may be achieved only by increasing the number of dimensions to 26 at the level of classical theory. A generalization of Noether's theorem is presented along with an action principle derivation leading to extraction of the Poincare group generator. It is shown how to quantize the theory and concluding remarks are made relating gauge invariance and interaction of these models. (1 figure) (SDF)

00775 (ORO—3992-223) **Exact magnetic monopole solutions in Yang—Mills' and unified gauge theories.** Hsu, J.P. (Texas Univ., Austin (USA). Center for Particle Theory). 1975. 17p. Dep. NTIS $4.00.

Magnetic monopoles are studied in non-Abelian gauge theories. The exact static spherically symmetric solutions of the magnetic monopoles in both Yang—Mills' and unified gauge theories are obtained. The energy E of the static system is calculable and it is either zero or infinite. The existence of the magnetic monopole solution is a consequence of symmetry rather than dynamics. A new definition of the electromagnetic field tensor is proposed which relates the static solution of gauge fields and the magnetic monopole solution. Experimental implications are discussed. (auth)

00776 (ORO—3992-224) **Violation of unitarity in a finite quantum electrodynamics.** Hsu, J.P.; Mac, E. (Texas Univ., Austin (USA). Center for Particle Theory). Aug 1975. 8p. Dep. NTIS $4.00.

By explicit calculations, we show the violation of unitarity in a recently proposed theory of finite quantum electrodynamics on the basis of a limiting procedure. The failure can be traced back to the mathematical non-existence of the limit upon which the theory is built. (auth)

00777 **Self-interacting, boson, quantum field theory, and the thermodynamic limit in d dimensions.** Baker, G.A. Jr. (Brookhaven National Lab., Upton, NY). *J. Math. Phys. (N.Y.)*; 16: No. 6, 1324-1346(Jun 1975).

By use of a finite volume, lattice approximation, an approximation to the analytic continuation of a polynomial, self-interacting boson quantum field theory from Minkowski space to Euclidean space was set up. The infinite volume limit for various boundary conditions is shown to exist and to be asymptotic to the perturbation expansion in the coupling constant g at g = 0. For g: phi^4: d theory mass renormalizability is proved and it is shown how, by use of Nelson's reconstruction theorem, the corresponding Minkowski space quantum field theory can be obtained. It is discussed, at least for d greater than or equal to 4, how statistical mechanical techniques, used to analyze the Ising model in the critical region just above the critical temperature, can be used to compute the properties of quantum field theory. (auth)

NEUTRON INTERACTIONS WITH MATTER

00778 (COO—2509-3) **Kinetic theory of neutron gases. Progress report, October 1, 1974—June 30, 1975.** Goldstein, H.; Cacuci, D.; Ku, L.P.; Ostrow, S.; Peng, W. (Columbia Univ., New York (USA). Div. of Nuclear Science and Engineering). 1975. Contract AT(11-1)-2509. 11p. Dep. NTIS $4.00.

Interim progress reports are presented on four investigations involving the transport of fast neutrons. The common theme tying together the four research projects is the manner in which details of microscopic cross sections affect the macroscopic transport behavior of neutron gases in material media. In the first, the classic problem of transport and slowing down in a non-hydrogenous medium with constant cross section is being reexamined, using Case's method of singular eigenfunctions. Both the asymptotic limit derived by Wick and the age-theory extreme have been recovered, and higher order corrections to these are being derived. Semi-numerical techniques have been developed which should permit calculation of the flux over wide ranges of distance and lethargy. The second investigation is the study of the effects of square-well minima in otherwise constant cross sections. A specialized moments-method code has been developed for the purpose, which gives the flux as far out as 80 to 100 mfp from the source. A simple but highly accurate model has been developed to include the effects of the minima, and it is now feasible to predict under what conditions a given minimum will significantly affect the penetration. In the third study Monte Carlo has been used to obtain the characteristics of neutron histories penetrating to various distances and energies in iron. The role of such cross section phenomena as inelastic scattering and cross section minima is being elucidated. In the last investigation, the discrete energy S/sub N/ method is being applied to various transport problems difficult of access by other methods. For example, an examination is under way of the dependence of fast-neutron albedo on the form of representation of the scattered neutron distribution and on the fine structure of the cross section. (auth)

00779 (COO—3058-63) **Application of interactive graphics and continuous slowing down theory to the assessment of nuclear data files.** Danchak, M.; Becker, M.; Moyer, W.R. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA). Div. of Nuclear Engineering). 1972. Contract AT(11-1)-3058. 33p. Dep. NTIS $4.75.

An interactive graphics analysis system was applied to the assessment and modification of the neutron cross section sets for depleted uranium (ENDF/B-II) and iron (1124). The system, RIGAS, allows one to: perform on-line flux calculations based on continuous slowing down theory; instantly compare the plotted results with experiment; and visually and interactively change the slowing down parameters to force agreement with experiment. (11 figures, 2 tables) (auth)

00780 (LA—5952) **Method of characteristics for the transport equation solution.** Carlson, B.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. 30p. Dep. NTIS $4.00.

A method of characteristics is developed for the numerical solution of the multigroup discrete ordinates transport equation. A revised form of the diamond difference method is coordinated with the new approach and some alternate, possibly useful methods are developed. Also, several minor numerical difficulties that occasionally troubled calculations in the past have been resolved. (auth)

00781 (LA—5990-MS) **ONETRAN: a discrete ordinates finite element code for the solution of the one-dimensional multigroup transport equation.** Hill, T.R. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1975. 70p. Dep. NTIS $5.45.

ONETRAN solves the one-dimensional multigroup transport equation in plane, cylindrical, spherical, and two-angle plane geometries. Both regular and adjoint, inhomogeneous and homogeneous problems subject to vacuum, reflective, periodic, white, albedo or inhomogeneous boundary flux conditions are solved. General anisotropic scattering is allowed and anisotropic inhomogeneous sources are permitted. The discrete ordinates approximation for the angular variable is used with the diamond (central) difference approximation for the angular extrapolation in curved geometries. A linear discontinuous finite element representation for the angular flux in each spatial mesh cell is used. Negative fluxes are eliminated by a local set-to-zero and correct algorithm. Standard inner (within-group) iteration cycles are accelerated by system rebalance, coarse-mesh rebalance, or Chebyshev acceleration. Outer iteration cycles are accelerated by coarse-mesh rebalance. Provision is made for creation of standard interface output files for S/sub N/ constants, inhomogeneous sources, angle-integrated fluxes, and angular fluxes. Standard interface input files for S/sub N/ constants, inhomogeneous sources, cross sections, and total or angular fluxes may be read. All binary operations are localized in subroutines REED and RITE. Flexible edit options, including restart capability are provided. ONETRAN is designed for use with CDC-7600 and IBM 360. (12 tables, 10 figures) (auth)

00782 (ORNL—5025, pp 112-113) **Capture cross-section data analysis.** Macklin, R.L. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The nonlinear, least squares program ORGLS2 has been developed for neutron capture data analysis. Samples of fits to data are shown. (2 figures) (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

00783 (LA-UR—75-1265) **Parity nonconservation in two-nucleon systems.** Nagle, D.E. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 8p. (CONF-750631—6). Dep. NTIS $4.00.

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

The observation of a violation of the parity symmetry in two-nucleon systems implies the presence of a weak hadronic force. The positive effect reported by Lobashov et al. in the reaction np yields dγ, for the circular polarization of the gamma ray, would imply a large value for the parity nonconserving (PNC) amplitude. A transmission experiment has been undertaken for 15-MeV longitudinally polarized protons on hydrogen. A transmission experiment for 6-GeV polarized protons on Be and on H_2O is in progress at the ZGS at Argonne National Laboratory. The current results of the latter two experiments are summarized, and the relation to theoretical calculations is discussed. (2 figures, 1 table) (auth)

NUCLEAR REACTIONS AND SCATTERING

00784 (COO—2130-163, pp 240-271) **Two-center shell model and heavy-ion scattering.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

A two-center shell model is applied to heavy ion scattering. Various aspects of two-center potentials are examined and predictions are compared with experimental data. (16 figures) (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

00785 (LA-UR—75-1274) **Low energy pion—nucleon and pion—deuteron interactions.** Burman, R.L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 12p. (CONF-750631—7). Dep. NTIS $4.00.

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

This survey concentrates upon current experiments in the fields of pion-nucleon and pion-deuteron interactions, for low-energy incident pions—below 300 MeV. The discussion is restricted to very recent work. The topics to be covered are: $\pi^+{}^-$p yields $\pi^+{}^-$p, Elastic Scattering; $\pi^+{}^-$p yields $\pi^+{}^-$pγ, Bremsstrahlung; π^+d yields pp, Absorption; π^- d yields π^+d, Elastic Scattering; and π^+d yields π^+pn, Breakup. (14 figures) (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19 THEORETICAL

ENERGY LEVELS AND TRANSITIONS

00786 (COO—3001-118) **Application of the exp(s)-method to effective interactions in nuclei.** Offermann, R.; Ey, W.; Kuemmel, H. (State Univ. of New York, Stony Brook (USA); Bochum Univ. (F.R. Germany). Inst. fuer Theoretische Physik; Max-Planck-Institut fuer Chemie (Otto-Hahn-Inst.), Mainz (F.R. Germany). Kernphysikalische Abt.). 1975. Contract AT(11-1)-3001. 46p. Dep. NTIS $5.50.

The exp(s)-method—applied before to ground states of doubly magic nuclei only—is extended to open shell nuclei. Cellular type approximations are made and justified. A comparison with perturbation theory is made using ^{16}O as an example. A new grouping of the (folded) diagram expansion is obtained and seems to be favored by the numerical results. (auth)

NUCLEAR REACTIONS AND SCATTERING

00787 (ORNL—5025, pp 38-40) **Statistical analysis of fine structure in $^{12}C + ^{12}C$ reactions.** Stokstad, R.G. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The yields of gamma rays from ($^{12}C + ^{13}C$) reactions have been measured from 3 to 12 MeV (c.m.) in which gamma transitions from the first excited states to the ground state were observed in ^{21}Ne and ^{21}Na. The gross dependence of the cross sections on bombarding energy is being analyzed in terms of various barrier penetration models and the optical model. A statistical analysis has tentatively suggested the existence of nonstatistical resonances in the alpha particle channels. (2 figures) (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

00788 (COO—2130-163, pp 98-132) **Selected short subjects.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

Eight-particle transfer reactions, nuclear level structure, and other information provided by heavy ion reactions are briefly examined. (30 figures) (SDF)

ENERGY LEVELS AND TRANSITIONS

00789 (LA-UR—75-1278) **Parity violation in P—P and P—Be reactions.** Nagle, D.E. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 8p. (CONF-750636—2). Dep. NTIS $4.00.

From 5. international conference on neutrino science; Balaton, Hungary (16 Jun 1975).

The observation of a violation of the parity symmetry in two-nucleon systems implies the presence of a weak hadronic force. The positive effect reported by Lobashov in the reaction np yields dy, for the circular polarization of the gamma ray, would imply a large value for the parity nonconserving (PNC) amplitude. A transmission experiment has been undertaken for 15-MeV longitudinally polarized protons on hydrogen. A transmission experiment for 6-GeV polarized protons on Be and on H_2O is in progress at the ZGS at Argonne National Laboratory. The current results of the latter two experiments are summarized, and the relation to theoretical calculations is discussed. (2 figures, 1 table) (auth)

NUCLEAR REACTIONS AND SCATTERING

00790 (COO—1195-342) **Dimuon production by high energy neutrons.** Messner, R.; O'Halloran, T.; Wattenberg, A. (Illinois Univ., Urbana (USA)). May 1975. 11p. (CONF-750654—5). Dep. NTIS $4.00.

From High energy particle physics divisional conference of EPS; Palermo, Italy (23 Jun 1975).

Measurements studying the reaction n + Be $\mu^+\mu^-$ + X with high-energy neutrons produced by 300-GeV and 380-GeV protons at Fermilab are reported. As a preliminary report has already been published on the 300-GeV data, the emphasis is on the more recent results obtained at higher energies. The detecting apparatus is briefly described; then dimuon mass distributions are presented. Distributions of dimuon pairs as a function of longitudinal and transverse momentum are also shown. It is suggested that the mechanisms involved in the production at lower energies may be different from the ones at these energies. (7 figures) (RWR)

00791 (HASL—293) **Total neutron cross sections from 15 MeV to 25.5 GeV for isotopes with mass numbers, 12 less than or equal to A less than or equal to 64.** Sanna, R.S. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). Apr 1975. 22p. Dep. NTIS $4.00.

The need for a compilation of neutron cross-section data above 15 MeV became apparent during projects involving the computation of multisphere neutron spectrometer responses and the use of existing transport codes for calculating atmospheric cosmic rays. A compilation of total neutron cross-section data in the energy range 15 MeV to 25.5 GeV is described for isotopes with mass numbers 12 less than or equal to A less than or equal to 64. (3 figures, 4 tables, 31 references) (auth)

00792 (LBL—3633) **Single particle inclusive spectra resulting from the collision of relativistic protons, deuterons, alpha particles, and carbon ions with nuclei.** Papp, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1975. Contract W-7405-ENG-48. 207p. Dep. NTIS $13.50.

Thesis.

The yields of positive and negative particles resulting from the collision of 1.05 GeV/nucleon and 2.1 GeV/nucleon protons, deuterons, alpha particles, and 1.05 GeV/nucleon carbon nuclei with various targets have been measured. Single particle inclusive cross sections for production of π^+, π^-, p, d, ^3H, ^3He, and ^4He at 2.5° (lab) were obtained. How the results bear on the concepts of limiting fragmentation and scaling, the structure of the alpha particle and deuteron, and the possibility of "coherent" production of pions by heavy ions are discussed. (auth)

00793 (LBL—3861) **Production of ^{11}C by the interaction of 375 MeV/amu Ne^{10+} ions with carbon.** Smith, A.R.; Thomas, R.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

The reaction cross section for production of ^{11}C from ^{13}C in a polystyrene target has been measured with incident 375-MeV/amu Ne^{10+} ions at the Lawrence Berkeley Laboratory's Bevalac. A broad beam irradiation was used, and both beam profile and absolute particle fluence were determined with LiF thermoluminescent dosimeters, which had been calibrated by track counting in nuclear emulsions; the induced target activity was measured with a NaI(Tl)-crystal, γ-ray spectrometer. The reaction cross section was 75 +- 7 mb. (1 figure, 1 table) (auth)

00794 (ORNL—5025, pp 234-236) **Thick-target neutron yields from d + Be and d + Li at E/sub d/=40 MeV.** Smith, G.J.; Saltmarsh, M.J. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The neutron spectra from the Li(d,n) and Be(d,n) reactions have been measured at scattering angles between 0 and 20°. The target thicknesses were chosen to be slightly greater than the range of 40-MeV deuterons, the lithium being 1.04 g/cm² and the beryllium 1.07 g/cm². Time-of-flight measurements were made using a cylinder of NE 213 liquid scintillator 3.97 cm in diameter by 4.45 cm long viewed by an XP1020 photomultiplier tube. (auth)

00795 (ORNL-TM—4823) **Production of low energy gamma rays by neutron interactions with fluorine for incident neutron energies between 0.1 and 20 MeV.** Morgan, G.L.; Dickens, J.K. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 34p. Dep. NTIS $4.75.

Differential cross sections for the production of low-energy gamma rays (less than 240 keV) by neutron interactions in fluorine have been measured for neutron energies between 0.1 and 20 MeV. The Oak Ridge Electron Linear Accelerator was used as the neutron source. Gamma rays were detected at 92° using an intrinsic germanium detector. Incident neutron energies were determined by time-of-flight techniques. Tables are presented for the production cross sections of three gamma rays having energies of 96, 110, and 197 keV. (14 figures, 3 tables) (auth)

00796 (ORO—4856-13) **Study of (p,2p) reaction on ^7Li and ^{12}C at 100 MeV. Technical report 75-093.** Bhowmik, R.K.; Chang, C.C.; Didelez, J.P.; Holmgren, H.D. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jun 1975. 37p. Dep. NTIS $5.00.

The (p,2p) reactions on the target nuclei ^7Li and ^{12}C have been studied at 100 MeV bombarding energy. The energies of both the outgoing protons have been measured in coincidence in a coplanar symmetric geometry with good energy and momentum resolution in order to separate the different excited states of the residual nuclei. The experimental data are presented in a form suitable for direct comparison with theory. The distorted wave impulse approximation model (DWIA) can explain the qualitative features of the energy sharing and angular correlation spectra. The detailed quantitative agreement with DWIA is however somewhat

poor indicating the necessity of a more exact treatment of the three body reaction. (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

00797 (COO—3496-50, pp 91-96) **Statistical description of interacting fermions including angular momentum.** Behkami, A.N. (Pahlavi Univ., Shiraz, Iran); Huizenga, J.R. (Pahlavi Univ., Shiraz, Iran). 1975.

Studies of nuclear fission, low energy nuclear reactions and transuranic nuclei. Progress report, 1 June 1974—1 June 1975.

NUCLEAR REACTIONS AND SCATTERING

00798 (COO—2171-45) **Theoretical predictions for alpha particle spectroscopic strengths.** Draayer, J.P. (Rochester Univ., N.Y. (USA). Dept. of Physics and Astronomy). 12 May 1975. Contract E(11-1)-2171. 38p. Dep. NTIS $5.00.

Multinucleon transfers induced in heavy-ion reactions of the type (^{6}Li,d) furnish a selective probe with which to study the interplay between rotational and clustering phenomena so characteristic of the structure of the light sd-shell nuclei. For these nuclei, theoretical predictions for inter-band as well as intra-band transfer strengths can be made using recently tabulated results for angular momentum dependent SU_3 inclusion R_3 relative spectroscopic strengths and angular momentum independent SU_6 inclusion SU_3 coefficients of fractional parentage. The pure SU_3 (oscillator)-SU_4 (supermultiplet) symmetry limit agrees well with results obtained using available eigenfunctions determined in large shell model calculations. In particular, the scalar nature of a transferred "alpha"-cluster insures that the effect of spatial symmetry admixtures in the initial and final states of the target and residual nuclei are minimized. Sum rule quantities provide a measure of the probable effects of symmetry breaking. Strength variations within a band are expected; transfers to core excited states are often favored. Results extracted from exact finite range DWBA analyses of (^{6}Li,d) data on ^{16,18}O, ^{20,21,22}Ne, ^{24,25}Mg show some anomalies in our understanding of the structure and/or reaction mechanisms. (18 figures) (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

RADIOACTIVE DECAY

00799 (BNL—20087) **Masses of T/sub z/ = +5/2 nuclei in the s—d shell from β—decay measurements.** Alburger, D.E.; Goosman, D.R.; Davids, C.N.; Hardy, J.C. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 9p. (CONF-750648—1). Dep. NTIS $4.00.

From 5. international conference on atomic masses and fundamental constants; Paris, France (2 Jun 1975).

In this work the existence of five new T/sub z/ = +$^5/_2$ nuclides, ^{33}F, ^{29}Mg, ^{31}Al, ^{33}Si, and ^{35}P, was established; their properties, including mass values, were determined, along with those of ^{25}Ne and ^{27}Na. Two experimental techniques were used, the "rabbit" transfer of a solid target and the gas transfer system; some novel features of these are described. A β spectrum of ^{33}Si observed in coincidence with 1848-keV γ rays is shown; a mass excess of -20569 +- 50 keV was derived for ^{33}Si. Attempts to produce ^{31}O were unsuccessful. Comparisons of the measured masses of the T/sub z/ = +$^5/_2$ nuclides in the 2s—1d shell with predictions of the Garvey—Kelson mass formulation and with shell-model calculations are shown. The latter produce considerably better agreement with experiment. (3 figures, 1 table) (RWR)

ENERGY LEVELS AND TRANSITIONS

00800 (ORNL—5025, pp 82-85) **States in ^{24}Mg populated by the ^{10}B(^{16}O,d)^{24}Mg and ^{12}C(^{16}O,α)^{24}Mg reactions.** Ford, J.L.C. Jr.; Gomez del Campo, J.; Robinson, R.L.; Stelson, P.H.; Thornton, S.T. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

High spin states in ^{24}Mg populated by the ^{10}B(^{16}O,d) and ^{12}C(^{16}O,) reactions have been investigated, and the data have been used to check the suitability of the Hauser-Feshbach (H-F) technique for determining spin values. It is concluded that the H-F method, coupled with additional information, may be a significant means for locating high spin states. (4 figures) (SDF)

NUCLEAR REACTIONS AND SCATTERING

00801 (ANL/NDM—13) **Response of several threshold reactions in reference fission neutron fields.** Smith, D.L.; Meadows, J.W. (Argonne National Lab., Ill. (USA)). Jun 1975. Contract W-31-109-Eng-38. 44p. Dep. NTIS $5.25.

Cross sections for (n,p) reactions on ^{27}Al, ^{46,47,48}Ti, ^{54,56}Fe, ^{58}Ni, ^{59}Co, and ^{64}Zn and for ^{238}U fission have been measured relative to fission cross sections for ^{235}U or ^{238}U and the results of this work have been reported. These data have been renormalized to accommodate recent revisions of the ^{235}U and ^{238}U fission evaluated cross sections which are accounted for in the ENDF/B-IV files. The response of the renormalized data to two commonly used reference neutron fields have been investigated: i) pure thermal-neutron fission of ^{235}U, and ii) the spontaneous fission of ^{252}Cf. The results of this analysis and a comparison with corresponding recent information from the literature are discussed. Two additional topics are addressed in appendices: i) the preparation and calibration of uranium deposits used in cross section measurements, and ii) errata in some earlier reports from our laboratory on this same general subject. (10 figures, 14 tables) (SDF)

00802 (COO—2130-163, pp 24-62) **Mechanisms of heavy-ion reactions: direct or compound.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

Reaction mechanisms are discussed for the following: ^{16}O(^{6}Li,d), ^{16}O(^{7}Li,t), ^{24}Mg(d,^{6}Li)^{20}Ne, ^{16}O(^{6}Li,^{3}He) and ^{12}C(^{12}C, α). (LBS)

00803 (COO—2130-163, pp 63-97) **Nuclear structure information from heavy-ion reaction studies.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

Heavy ion reactions are discussed in their role as a tool for obtaining nuclear level structure information. Details are provided for nuclei near ^{20}Ne. (35 figures) (SDF)

00804 (COO—3126-29) **Neutron-absorption cross section of sodium-22.** Rundberg, R.; Elgart, M.F.; Finston, H.L.; Williams, E.T.; Bond, A.H. Jr. (Brooklyn Coll., N.Y. (USA)). 1975. 3p. (CONF-750303—70). Dep. NTIS $4.00.

From Proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A simple method for determining the neutron-absorption cross sections for radionuclides produced and consumed in a reactor-neutron flux is described. Data were obtained for ^{22}Na which, through application of Westcott's procedure, yielded the following: $sigma_0$ = 51.5 +- 3.1 kbarns, s_0 = 2.3 +- 0.1, and Σ' = 100 +- 10 kbarns. (3 tables) (auth)

00805 (ORNL—5025, pp 44) **Study of the (^{6}Li,^{6}He) reaction and the distribution of Gamow-Teller strength.** Goodman, C.D.; Wharton, W.R.; Hensley, D.C. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

For a quasi-elastic (^{6}Li,^{6}He) reaction, the Gamow-Teller matrix elements may be obtained from the zero average momentum transfer cross section. With this in mind, a series of experiments has been initiated to determine the conditions under which the quasi-elastic process dominates the cross section in the (^{6}Li,^{6}He) reaction. Angular distribution data from ^{14}C(^{6}Li,^{6}He)^{14}N suggest that the quasi-elastic process dominates at forward angles for 60 MeV ^{6}Li. (1 figure) (SDF)

00806 (ORNL—5025, pp 46-49) **Angular distributions for elastic and inelastic scattering of ^{12}C + ^{12}C.** Stokstad, R.G.; Halbert, M.L.; Hensley, D.C.; Fulmer, C.B.; Raman, S.; Snell, A.H.; Stelson, P.H. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Angular distributions for elastic and inelastic scattering of ^{12}C by ^{12}C were measured at several energies between 74.2 and 117.1 MeV. Salient features of the experimental results are described. (4 figures) (SDF)

00807 (ORNL—5025, pp 86-87) **Population of high-spin states in ^{23}Na through the ^{11}B(^{16}O,α) reaction.** Gomez del Campo, J.; Gustafson, D.E.; Robinson, R.L.; Stelson, P.H.; Miller, P.D.; Bair, J.K.; McGrory, J.B. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The average angular distributions for the reaction ^{11}B(^{16}O, α)^{23}Na have been measured along with differential cross sections for states excited in ^{23}Na up to 15 MeV. Experimental results were compared with average compound nucleus cross sections calcu-

lated with the Hauser—Feshbach expressions for total and differential cross sections using the code HELGA. (1 figure) (SDF)

00808 (ORNL—5025, pp 116-119) **Neutron total cross sections of fluorine and silicon.** Johnson, C.H.; Larson, D.C.; Harvey, J.A.; Hill, N.W. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The total cross section of fluorine was measured by the neutron time of flight method. The total neutron cross section for silicon has also been obtained for energies between 5 eV and 700 keV. Good agreement with good-resolution data above 200 keV has been found. (2 figures) (SDF)

00809 (ORNL—5025, pp 114-116) **Neutron capture cross section of ^{32}S to 850 keV.** Halperin, J.; Macklin, R.L. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The radiative capture neutron cross section has been obtained for ^{32}S in the energy range 2.5 to 850 keV. Energies of observed resonances, capture strength, and total widths from unresolved resonances are tabulated. (1 table, 1 figure) (SDF)

00810 (UCID—16857) **Identification of radioactive nuclides produced with ions accelerated by the LLL collective-field accelerator.** Howerton, R.J.; Luce, J.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Aug 1975. Contract W-7405-Eng-48. 27p. Dep. NTIS $4.50.

^{12}C and ^{19}F ions accelerated by the LLL Collective-Field Ion Accelerator were impinged upon Al, Cu, Mo, and Ta targets. Gamma-Ray spectroscopic analysis of induced activities resulted in the identification of 22 isotopes not previously reported as having been activated by ^{12}C or ^{19}F induced reactions. Seven isotopes were also identified that had previously been seen by other workers using conventionally produced ion beams. The energy of the ^{12}C particles is inferred to be about 7 MeV per nucleon. The ^{19}F ions have a most probable energy in excess of 80 MeV. (8 tables) (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, THEORETICAL

00811 (CALT—63-229, pp 12-14) **Ultra-low temperature nuclear physics; time reversal.** Boehm, F.; Cohen, R.J.; Cheung, N.K.; Henrikson, H.E. 7 May 1975.

Research in nuclear physics at low and intermediate energies, and x-rays. Budget proposal and progress report, 1 October 1975—30 September 1976.

NUCLEAR REACTIONS AND SCATTERING

00812 (COO—3494-25, pp 28-38) **Preequilibrium decay calculations: a general model approach.** Mignerey, A.; Scobel, W.; Blann, M. 1975.

Nuclear reaction mechanisms. Progress report, June 1974—May 1975.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

00813 (ORNL—5025, pp 87-89) **^{44}Ca yrast levels.** Kim, H.J.; Robinson, R.L.; Milner, W.T. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Results of high spin studies on ^{44}Ca as a result of 30-40 MeV ^{16}O bombardment of ^{28}Si are reported. The observed levels compare well with thermal neutron capture results. (2 figures) (SDF)

00814 (ORNL—5025, pp 89-90) **Lifetime of the 3.830-MeV state of ^{41}Ca.** Kim, H.J.; Robinson, R.L.; Milner, W.T. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The lifetime of the 3.830 MeV state in ^{41}Ca has been determined from the measured delayed coincidence time distribution between neutrons and gamma rays from the reaction ^{28}Si(^{16}O,2pnγ)^{41}Ca at 40 MeV. The result is 4.16 +- 0.20 nsec. (1 figure) (SDF)

NUCLEAR REACTIONS AND SCATTERING

00815 (COO—3239-12, pp 34-40) **^{49}Ti(p,2p)^{47}Sc and ^{49}Ti(p,pπ^{+})^{48}Sc cross sections at 11.5 and 300 GeV.** Yester, M.V. May 1975.

Nuclear chemistry research of high energy nuclear reactions at Carnegie-Mellon University. Progress report, 1974—1975.

00816 (COO—3494-25, pp 22-27) **Precompound analysis of (p,n) reactions.** Galonsky, A.; Patterson, D.M.; Doering, X.; Blann, M. 1975.

Nuclear reaction mechanisms. Progress report, June 1974—May 1975.

00817 (ORNL—5025, pp 61-64) **Study of the giant resonance region and bound states in ^{58}Ni, using inelastic scattering of polarized protons.** Kocher, D.C.; Bertrand, F.E.; Gross, E.E.; Newman, E. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Studies of the giant resonance region of the nuclear continuum have continued with a series of experiments of ^{58}Ni(p,p′) using a 60 MeV polarized proton beam. Data was taken to check previously measured analyzing powers for the E2 resonance. To check theoretical predictions (DWBA), data were also obtained for analyzing powers for low lying bound states with known spin and parity. The present status of measurement and analysis of the E2 resonance, bound states, and elastic scattering is summarized. (4 figures) (SDF)

00818 (ORNL—5025, pp 64-65) **Isolation of the giant quadrupole resonance in ^{58}Ni via deuteron inelastic scattering.** Bertrand, F.E.; Newman, E.; Kocher, D.C.; Chang, C.C. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The giant resonance region of ^{58}Ni has been studied using the (d,d′) reaction with 70 and 46 MeV deuterons. The resonance cross sections for (d,d′) are generally more accurate than those obtained by other inelastic scattering experiments due to the absence of the E1 resonance and the relatively large ratio of resonance to continuum cross section. Comparison of data with DWBA provides strong additional evidence for identification of the E2 resonance. (2 figures) (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

00819 (ORNL—5025, pp 90-91) **High-spin yrast cascade in ^{60}Ni.** Kim, H.J.; Ballini, R.; Delaunay, B.; Delaunay, J.; Fouan, J.P.; Pichevar, M. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

High spin states in ^{60}Ni have been investigated via the ^{58}Ni(α,2pbγ) ^{60}Ni, ^{56}Cr(^{12}C,2p γ) ^{60}Ni, and ^{49}Ti(^{16}O,2p γ) ^{60}Ni reactions. The level scheme determined from these measurements is presented. (SDF)

00820 (ORNL—5025, pp 93-95) **Levels in ^{72}Se observed via in-beam gamma-ray spectroscopy in the ^{58}Ni(^{16}O,2p) reaction.** Crowell, H.L.; Collins, W.E.; Hamilton, J.H.; Robinson, R.L.; Sayer, R.O.; Kim, H.J. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Levels in ^{72}Se were observed via in-beam gamma spectroscopy following the ^{58}Ni(^{16}O,2p) reaction. Spectra and partial energy level schemes are shown. (3 figures) (SDF)

00821 (ORNL—5025, pp 95-96) **Lifetimes of high-spin states in ^{72}Se.** Hamilton, J.H.; Crowell, H.L.; Robinson, R.L.; Collins, W.E.; Ramayya, A.V.; Ronningen, R.M.; Singhal, N.C.; Kim, H.J. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

High spin states in ^{72}Se populated in the ^{58}Ni(^{16}O,2p) reaction have been investigated. Preliminary results are given for mean lifetimes of the 6^{+}, 8^{+}, 10^{+}, and 12^{+} states. These represent the first lifetime measurements for such high spin states in lighter mass nuclei. (3 figures) (SDF)

00822 (ORNL—5025, pp 97-98) **Mean life of the 0_2^{+} state at 854 keV in ^{74}Se.** Ramayya, A.V.; Ronningen, R.M.; Hamilton, J.H.; Lourens, W.; Carter, H.K.; Sayer, R.O. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

In order to investigate the coexistence of spherical and deformed shapes in ^{74}Se, measurement of the lifetime of the O_2^+ state has been carried out. Comparison of ^{74}Se energy levels with those predicted for spherical and rotational models is presented. (2 figures) (SDF)

NUCLEAR REACTIONS AND SCATTERING

00823 (ANL/NDM—14) **Cross sections for the ^{66}Zn(n,p)^{66}Cu, ^{113}In(n,n')/sup 113m/In and ^{115}In(n,n')/sup 115m/In reactions from near threshold to 10 MeV.** Smith, D.L.; Meadows, J.W. (Argonne National Lab., Ill. (USA)). Jul 1975. 42p. Dep. NTIS $5.25.

Activation techniques were used in the measurement of cross sections for the ^{66}Zn(n,p)^{66}Cu, ^{113}In(n,n')/sup 113m/In and ^{115}In(n,n')/sup 115m/In reactions from near threshold to 10 MeV. The ^{7}Li(p,n)^{7}Be and D(d,n)^{3}He reactions were employed as sources of approximately monoenergetic neutrons. Neutron fluence was measured with a fission chamber which contained calibrated uranium deposits enriched in ^{235}U or ^{238}U. Gamma-ray activities of the irradiated samples were measured with NaI(Tl) scintillation and Ge(Li) detectors. The raw data were corrected for various experimental effects including activity decay, detector efficiencies, geometry, absorption, multiple scattering, internal conversion, deadtime, sum coincidences, and sample and uranium deposit properties. The response of the monoenergetic cross section data in reference neutron fields characteristic of thermal fission of ^{235}U and spontaneous fission of ^{252}Cf was numerically investigated. The results of our work are compared with corresponding information reported in the literature. (9 figures, 12 tables) (auth)

00824 (COO—3239-12, pp 51-56) **^{65}Cu + ^{12}C reaction at 126 MeV.** Spector, R.J. May 1975.

Nuclear chemistry research of high energy nuclear reactions at Carnegie-Mellon University. Progress report, 1974—1975.

00825 (COO—3494-25, pp 11-13) **Reactions of ^{40}Ar + ^{109}Ag and of ^{84}Kr + ^{65}Cu.** Britt, H.C.; Erkkila, B.; Stokes, R.H.; Gutbrod, H.H.; Plasil, F.; Ferguson, R.L.; Blann, M. 1975.

Nuclear reaction mechanisms. Progress report, June 1974—May 1975.

00826 (ORNL—5025, pp 98-99) **Absolute cross sections for the ^{65}Cu(^{16}O,X) reactions.** Wells, J.C. Jr.; Robinson, R.L.; Kim, H.J.; Ford, J.L.C. Jr. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Absolute cross sections for reaction products in the 38.5 to 51.0 MeV ^{16}O bombardment of ^{65}Cu are reported. Gamma spectroscopy was used to identify the products. Results are compared with predictions for the statistical decay from compound nuclei. (3 figures) (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

00827 (COO—2176-34) **Level density calculation for deformed nuclei.** Felvinci, J.P.; Cacuci, D.; Melkonian, E. (Columbia Univ., New York (USA)). 1975. 3p. (CONF-750303—73). Dep. NTIS $4.00.

From Proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Level densities for the rare earth and actinide nuclei have been calculated using a modified version of the Ericson formalism. The assumption was made, that K (the projection of J on the symmetry axis of the nucleus) is a good quantum number in the compound nucleus. Individual level densities for the different (K,J) values of the compound nucleus formed by low energy neutron interactions were calculated. The results show good agreement with the interpretation of recent results obtained on U-235 in this laboratory. Using the above calculations it is also possible to infer from the measured level densities the locations of the band heads of different K bands in the compound nucleus. The results also indicate that the K bands responsible for the level densities exclude the ground state rotational band. Levels built on the higher lying β and γ vibrational bands and their composites are sufficient in number to explain the observed level densities. (4 tables) (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

00828 (ORNL-TM—4896) **Revised light element library for the ORIGEN code.** Kee, C.W. (Oak Ridge National Lab., Tenn. (USA)). May 1975. Contract W-7405-eng-26. 67p. Dep. NTIS $6.50.

To extend the convenient areas of application of ORIGEN, a larger library was prepared for neutron activation studies. The new library includes 674 nuclides and all naturally occurring nuclides with atomic number less than 84. (auth)

RADIOACTIVE DECAY

00829 (UCRL—51846) **Nuclear decay scheme studies of 30-h ^{131}Te/sup m/, 25-min ^{131}Te/sup g/, and 55.5-min ^{105}Cd.** Jackson, S.V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract W-7405-Eng-48. 340p. Dep. NTIS $10.60.

Thesis.

High-resolution Ge(Li) detectors have been used to observe γ-ray singles and coincidence spectra of 30-h $^{11}/_2^-$, /sup 131m/Te, 25-min $^{3}/_2^+$, and 55.5-min $^{5}/_2^+$ ^{105}Cd. Sources of /sup 131m/Te and /sup 131g/Te were produced by neutron irradiation of enriched ^{130}Te metal, and, in the case of /sup 131m/Te, were chemically purified to remove the ^{131}I daughter. A total of 190 and 80 γ-rays are attributed to the decays of /sup 131m/Te and /sup 131g/Te, respectively; and 174 and 77 of these transitions have been placed in a ^{131}I level scheme involving 52 excited states. Absolute β group intensities were determined for the transitions to ^{131}I levels. Spin and parity assignments were made for all observed levels. The β feeding from the $^{11}/_2^-$ /sup 131m/Te to the $^{7}/_2^+$ ^{131}I ground state was determined to be (5.2 +- 3.0) percent (log ft = 10.5). The isomeric transition of $^{11}/_2^-$ /sup 131m/Te to $^{3}/_2^+$ /sup 131g/Te was determined to be (22.2 +- 1.6) percent. The 6-nsec isomer in ^{131}I at 1797 keV has been assigned as $^{15}/_2^-$ and interpreted as a $\pi\nu_1\nu_2$ three quasi-particle state. Sources of ^{105}Cd were produced via the ^{106}Cd(n,2n) reaction on enriched ^{106}CdO using 14 MeV neutrons. A total of 274 γ-rays are attributed to the decay of ^{105}Cd, and 248 of these have been placed in a ^{105}Ag level scheme involving 50 excited states. Absolute values for the β^+/EC transition intensities to ^{105}Ag levels were determined. The β^+/EC feeding from the $^{5}/_2^+$ ^{105}Cd to the $^{7}/_2^+$ 25.5-keV isomeric state in ^{105}Ag was determined to be (51.4 +- 4.0) percent (log ft = 5.4). Spin and parity assignments were made for all observed levels. The experimentally determined level structures of ^{131}I and ^{105}Cd are interpreted in terms of the shell model and core excitation considerations with emphasis placed on the core coupling model and the three-particle models. (54 figures, 12 tables, 179 references) (auth)

ENERGY LEVELS AND TRANSITIONS

00830 (IS-T—673) **On-line gamma—gamma angular correlation studies of cascades in ^{140}Ba, ^{90}Sr, and ^{140}Cs.** Alquist, L.J. (Ames Lab., Iowa (USA)). May 1975. Contract W-7405-eng-82. 148p. Dep. NTIS $10.50.

Thesis.

Angular correlation measurements were made on gamma-ray cascades in ^{140}Ba, ^{90}Sr, and ^{140}Cs. These fission-product activities were isobarically enhanced from Kr and Xe noble-gas parents, which were mass-separated by the TRISTAN isotope separator system. Levels in ^{140}Ba were populated from the 64-sec decay of ^{140}Cs, and in ^{140}Cs from the 14-sec decay of ^{140}Xe. Levels in ^{90}Sr were populated from the 2.7-min decay of ^{90}Rb, which was populated from the decay of ^{90}Kr. The most intense transitions were measured in coincidence with the first excited state to ground state transition in even-even ^{140}Ba and ^{90}Sr. The two-parameter mode of data accumulation was used to study cascades with transitions in coincidence with the 806-keV and 989-keV transitions in odd-odd ^{140}Cs. In the study of cascades in ^{140}Ba definite spin assignments were made for eight levels, and tentative spin assignments for five levels. For ^{90}Sr definite spin assignments were made for eight levels, and tentative assignments for six levels. A definite 1- spin-parity assignment was made for the 103-keV level in ^{140}Cs, and tentative assignments were made for five other levels. Values are given for the angular correlation coefficients, and limits of multipolarity mixing ratios are given where applicable. (44 figures, 3 tables) (auth)

00831 (ORNL—5025, pp 51-54) **Excitation energies of the h/sub 11/2/ and d /sub 3/2/ neutron states in ^{145}Gd and ^{147}Dy.** Toth, K.S.; Rainis, A.E.; Bingham, C.R.; Newman, E.; Carter, H.K.; Schmidt-Ott, W.D. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

A search for ^{147}Dy in the M4 isometric series at N = 81 was undertaken by bombarding at thin target of ^{141}Pr with ^{14}N. The data have established that the h/sub 11/2/ and d/sub 3/2/ neutron states in ^{147}Dy are 750.7 and 72.0 keV above the S/sub 1/2/ ground state. Results for ^{147}Gd suggest that the h/sub 11/2/ and d/sub 3/2/ states are located at 748.7 and 27.3 keV, respectively. A summary of the excitation energies of the s/sub 1/2/, d/sub 3/2/, and h/sub 11/2/ neutron states for N = 81 nuclei is provided. (2 figures, 1 table) (SDF)

00832 (ORNL—5025, pp 54-56) **Observation of 1$^+$(πh /sub 11/2/, νh /sub 9/2/) states in ^{148} ^{150} ^{152}Tb populated in the decay of their dysprosium parents.** Toth, K.S.; Newman, E.; Bingham, C.R.; Rainis, A.E.; Schmidt-Ott, W.D. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Experiments have been made to investigate details of the decay of ^{148}Dy and to confirm its nuclidic assignment. Gamma ray yields are presented as a function of bombarding energy for ^{12}C ions incident on ^{142}Nd. The proposed decay scheme is presented, and the 0$^+$ yields 1$^+$ beta transition is discussed. In addition, the proposed electron capture decay schemes of ^{150}Dy and ^{152}Dy are given. It is concluded that their beta decays proceed entirely through 1$^+$ states of their respective terbium daughters. (4 figures) (SDF)

NUCLEAR REACTIONS AND SCATTERING

00833 (COO—3239-12, pp 4-33) **Isobaric yield curves in the interaction of 720 MeV alpha particles with ^{92}Mo, ^{96}Mo, ^{100}Mo.** Ku, T.H.H. May 1975.

Nuclear chemistry research of high energy nuclear reactions at Carnegie-Mellon University. Progress report, 1974—1975.

00834 (COO—3239-12, pp 41-46) **Study of single nucleon knock-out reactions at high energies.** Yates, M.A. May 1975.

Nuclear chemistry research of high energy nuclear reactions at Carnegie-Mellon University. Progress report, 1974—1975.

00835 (COO—3239-12, pp 47-50) **Nuclear structure effects in pion induced nuclear reactions.** Yester, M.V.; Karol, P.J. May 1975.

Nuclear chemistry research of high energy nuclear reactions at Carnegie-Mellon University. Progress report, 1974—1975.

00836 (COO—3494-25, pp 14-17) **Activation cross sections for reactions of ^{109}Ag induced with ^{40}Ar ions.** Hille, M.; Hille, P.; Gutbrod, H.H.; Blann, M. 1975.

Nuclear reaction mechanisms. Progress report, June 1974—May 1975.

00837 (ORNL—5025, pp 32-34) **Heavy-ion-induced fission and fusion of medium-mass nuclei.** Plasil, F.; Pleasonton, F.; Ferguson, R.L.; Hahn, R.L. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Studies of fission and fusion were continued with ^{12}C and ^{20}Ne ions incident on targets ranging from ^{107}Ag to ^{141}Pr. Excitation functions for fission and for evaporation residues have been measured for the systems ^{107}Ag + ^{20}Ne, ^{133}Cs + ^{20}Ne, and ^{141}Pr + ^{12}C. Investigations are also continuing in order to obtain values for the fission barrier at zero angular momentum for light systems. It has been found that the lowering of the fission barrier with increasing angular momentum can be described semiquantitatively with the rotating liquid drop model. (SDF)

00838 (ORNL—5025, pp 40-42) **Elastic and inelastic scattering of 70-MeV ^{12}C ions from ^{144}Nd.** Hillis, D.L.; Gross, E.E.; Hensley, D.C.; Halbert, M.L.; Bingham, C.R.; Riedinger, L.L.; Scott, A.; Martin, D. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Incident ^{12}C ions were scattered from a ^{144}Nd target, and the reaction products were detected. Angular distributions were measured between 20 and 80 degrees in the lab system for 2$^+$, 4$^+$, and 3$^-$ states at 696, 1314, and 1511 keV respectively. Calculated deformation parameters are shown and compared with previous values. It is concluded that the observed interference effects for the 2$^+$ and 3$^-$ states of ^{144}Nd can be well described by the DWBA formalism, but that the two step nature of the 4$^+$ state requires a coupled channel approach. (1 figure, 1 table) (SDF)

00839 (ORNL—5025, pp 49-51) **Absolute cross sections for (^{14}N,4n) and (^{14}N,5n) reactions induced on ^{141}Pr and ^{142}Nd.** Schmidt-Ott, W.D.; Toth, K.S.; Zganjar, E.F. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Using measured alpha branches of ^{150}Dy, ^{151}Dy, ^{151}Ho, and ^{152}Ho, the cross sections for (^{14}N,4n) and (^{14}N,5n) reactions induced on ^{141}Pr and ^{142}Nd targets have been determined. Results are composed with experiment. (2 tables, 1 figure) (SDF)

00840 (ORNL—5025, pp 101-103) **Coulomb excitation of ^{113} ^{115}In.** Tuttle, W.K. III; Stelson, P.H.; McGowan, F.K.; Milner, W.T.; Raman, S.; Robinson, R.L. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

In order to test a model which predicts the structure of nuclei near closed shells to be described by coupling a particle or hole to a vibrating core, Coulomb excitation experiments have been performed on ^{113}In and ^{115}In. A summary of B(E2) values is obtained is provided. (1 figure, 1 table) (SDF)

00841 (ORNL—5025, pp 127-129) **Neutron capture gamma-ray studies.** Slaughter, G.G.; Raman, S.; Jurney, E.T.; Wells, J.C. Jr.; Carlton, R.F. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The energy levels in ^{144}Nd have been investigated in detail via the ^{143}Nd(n,γ) reaction with thermal and resonance neutrons. In thermal measurements, about 500 gamma rays in the 0.1 to 6.5 MeV region have been identified. The resonance measurements were able to distinguish many gamma rays which were questionable in the thermal studies. (n,γ) reactions with ^{118}Sn, ^{120}Sn, and ^{122}Sn have also been investigated, and the ^{121}Sn level scheme is presented. (2 figures) (SDF)

00842 (ORNL—5025, pp 103-106) **Investigation of ^{12}C + ^{144}Sm neutron transfer reactions near 70 MeV.** Ford, J.L.C. Jr.; Thornton, S.T.; Friedland, E.; Wiedner, C.A.; Goldschmidt, M. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Data for the ^{144}Sm(^{12}C,^{12}C)^{144}Sm and ^{144}Sm(^{13}C,^{14}C)^{143}Sm reactions were taken at incident energies of 66 and 72 MeV respectively. In addition, elastic scattering of ^{12}C from ^{144}Sm at 66 MeV was performed to obtain optical model parameters for cross section calculations. Experimental cross sections along with DWBA predictions for ^{144}Sm(^{13}C,^{14}C) and spectroscopic factors for ^{143}Sm are given. Results for the ^{144}Sm(^{12}C,^{12}C) reaction are not as clear. (2 figures, 1 table) (SDF)

00843 (ORNL—5025, pp 42-44) **Transfer reactions and coulomb—nuclear interference induced by ^{12}C ions on ^{90}Zr and ^{208}Pb.** Toth, K.S.; Ford, J.L.C. Jr.; Gross, E.E.; Hensley, D.C.; Gustafson, D.E.; Thornton, S.T. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Reaction mechanism studies on magic shell nuclei have been continued using heavy ion reactions. Angular distributions for the single nucleon transfer reactions (^{12}C,^{13}C) and (^{12}C,^{11}B) on ^{208}Pb at an incident energy of 98 MeV are shown along with the spectrum at 45 degrees. Inelastic scattering to the 3$^-$, 5$^-$, and 2$^+$ states at 2.61, 3.20, and 4.10 MeV in ^{208}Pb was also measured. In addition, ^{12}C elastic and inelastic scattering on ^{90}Zr were studied. Effects of the interference between Coulomb and nuclear excitation were observed. (3 figures) (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

00844 (ORNL—5025, pp 28-31) **Dominance of the i/sub 13/2/ neutron in ytterbium backbending.** Riedinger, L.L.; Smith, G.J.; Stelson, P.H.; Eichler, E.; Hensley, D.C.; Johnson, N.R.; Robinson, R.L.; Sayer, R.O. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Experiments have been performed in order to work out the details of the ^{162}Yb level scheme, populated in the ^{156}Gd(^{12}C,3n) and ^{148}Nd(^{22}Ne,5n) reactions. The central role of the i/sub 13/2/ neutron orbitals to the backbending phenomena in ^{162}Yb was established. (3 figures, 1 table) (SDF)

NUCLEAR REACTIONS AND SCATTERING

00845 (ORNL—5025, pp 122-125) **Level spacing and s-wave neutron strength function of ^{180}Ta+n.** Harvey, J.A.; Hill, N.W.; Mapoles, E.R. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Neutron transmission measurements were made on a sample of ^{181}Ta enriched to 5.47 percent in ^{180}Ta and a matching sample of natural tantalum (0.01 percent ^{180}Ta) in order to correct for ^{181}Ta resonances. ^{180}Ta resonance parameters obtained from shape analysis are tabulated. (3 figures, 1 table) (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

00846 (ORNL—5025, pp 68-79) **UNISOR project.** May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The decay of the members of the A = mass chain beginning with ^{189}Tl has been studied by obtaining gamma and conversion electron multiscaled singles spectra, and gamma-gamma and conversion electron-gamma coincidence data. Data confirm a shift in the Yrast cascade in both ^{184}Hg and ^{186}Hg and provide evidence for band crossing in ^{188}Hg. Under investigation are the A = 189 chain beginning with thallium and the A = 191 chain beginning with lead. General features of these decay chains are discussed. The excited states of ^{189}Au and ^{191}Au have also been studied through decay of the corresponding mercury parent. Positron decay Q values have been measured for some neutron deficient Tl, Hg, Xe, and I isotopes. Results are tentative. In addition, study of deformation effects in the mass 190 region has been extended to thallium by lead decays and a value has been obtained for the half life of the ^{193}Pb high spin isomer. (8 figures, 1 table) (SDF)

ENERGY LEVELS AND TRANSITIONS

00847 (ORNL—5025, pp 31-32) **Rotational bands in even-A nuclei.** Riedinger, L.L.; Smith, G.J.; Stelson, P.H.; Eichler, E.; Hensley, D.C.; Hubert, P.; Johnson, N.R.; Robinson, R.L.; Sayer, R.O. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Angular distribution experiments on gamma rays of ^{170}W and ^{176}Os produced in the reactions (^{20}Ne,6n) have been performed in order to augment earlier research in backbending in these nuclei. Results are shown for the reaction ^{162}(20Ne,6n)^{176}Os. (1 table) (SDF)

00848 (ORNL—5025, pp 32) **Lifetimes of rotational states in ^{164}Dy by the Doppler-shift recoil distance method.** Sayer, R.O.; Sturm, R.J.; Johnson, N.R.; Eichler, E.; Singhal, N.C.; Guidry, M.W.; O'Kelley, G.D. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

00849 (ORNL—5025, pp 56-60) **Alpha-decay branching ratios for ^{151}Tb, $^{150\ 151\ 152\ 152}$Dy, and $^{152\ 153\ 154\ 155}$Er.** Toth, K.S.; Bingham, C.R.; Schmidt-Ott, W.D. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

Isotopes of erbium, dysprosium, and terbium were produced by ^{12}C bombardment of ^{147}Sm and ^{144}Nd. Their alpha branching ratios were deduced from kα x-ray intensities and decay schemes. The decay data was then considered within a theoretical framework to obtain alpha decay reduced widths. (2 figures, 3 tables) (SDF)

MOMENTS AND SPIN

00850 (ORNL—5025, pp 99-101) **Electric quadrupole moment of the 2$^{+'}$ state in ^{166}Er.** McGowan, F.K.; Milner, W.T.; Sayer, R.O.; Robinson, R.L.; Stelson, P.H. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The Coulomb excitation reaction has been used to investigate the static electric quadrupole moment of the 2$^{+'}$ state in ^{166}Er. Experimental excitation probabilities are compared with calculated probabilities from a semi classical coupled channels code. (1 figure) (SDF)

NUCLEAR REACTIONS AND SCATTERING

00851 (COO—2176-40, pp 11-14) **Capture resonance parameters of Tm-169.** Arbo, J.; Felvinci, J.; Melkonian, E.; Havens, W.W. Jr. 1975.

Neutron spectroscopy. Progress report, 1 July 1974—30 June 1975.

00852 (COO—3496-50, pp 3-10) **Two-neutron transfer on even—even osmium nuclei.** Thompson, R.C. (Eastman Kodak Co., Rochester, NY); Boyno, J.S.; Huizenga, J.R.; Burke, D.G.; Elze, Th.W. 1975.

Studies of nuclear fission, low energy nuclear reactions and transuranic nuclei. Progress report, 1 June 1974—1 June 1975.

00853 (ORNL—5025, pp 34-36) **Reactions of ^{40}Ar with ^{160}Dy and ^{174}Yb.** Hahn, R.L.; Toth, K.S.; LeBeyec, Y.; Eppley, R. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The excitation functions for the reactions of ^{40}Ar with ^{160}Dy and ^{144}Yb leading to the compound nucleus ^{200}Po have been determined. The study is part of a project to compare the reactions ^{160}Dy + ^{40}Ar and ^{116}Cd + ^{84}Kr leading to ^{200}Po, with the reactions ^{174}Yb + ^{40}Ar and ^{130}Te + ^{84}Kr leading to the compound nucleus ^{214}Ra. (3 figures) (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

00854 (ANL—8153, pp 18-32) **Nuclear structure and properties and nuclear-atomic interactions.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

The status of theoretical and experimental studies of the nature of residual nuclear interactions and their effect on nuclear excited states in actinide elements is reported. Information obtained concerning nuclear-atomic interactions is discussed. In addition, investigations of alpha and electron capture decay, core emission in beta decay, and beta spectrum shapes are described for several heavy elements. A new measurement of the half-life of ^{233}U is included. (SDF)

00855 (COO—3496-50, pp 36-46) **Study of strongly damped collisions.** Birkelund, J.R. (Univ., Marburg, Ger.); Huizenga, J.R.; Freiesleben, H.; Wolf, K.L.; Unik, J.P.; Viola, V.E. 1975.

Studies of nuclear fission, low energy nuclear reactions and transuranic nuclei. Progress report, 1 June 1974—1 June 1975.

00856 (COO—3496-50, pp 58-68) **Elastic scattering of ^{40}Ar and ^{84}Kr on ^{209}Bi and ^{238}U.** Birkelund, J.R. (Univ., Marburg, Ger.); Huizenga, J.R.; Freiesleben, H.; Wolf, K.L.; Unik, J.P.; Viola, V.E. 1975.

Studies of nuclear fission, low energy nuclear reactions and transuranic nuclei. Progress report, 1 June 1974—1 June 1975.

00857 (ORNL—5025, pp 108-110) **Gold neutron capture cross section from 3 to 550 keV.** Macklin, R.L.; Halperin, J.; Winters, R.R. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

A precise measurement of the gold thermal neutron capture cross section from 3 to 500 keV has been achieved with unprecedented resolution. (3 figures) (SDF)

00858 (ORNL—5025, pp 126-127) **Value of high-resolution neutron total cross sections of ^{206}Pb.** Harvey, J.A.; Hill, N.W. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

The total neutron cross section of ^{206}Pb has been obtained. The information that can be gained from it is briefly discussed. (1 figure) (SDF)

00859 (ORNL-TM—4973) **Au(n,xγ) reaction cross section for incident neutron energies between 0.2 and 20.0 MeV.** Morgan, G.L.; Newman, E. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 56p. Dep. NTIS $6.00.

Differential cross sections for the neutron-induced gamma-ray production from natural gold were measured for incident neutron energies between 0.2 and 20.0 MeV. The Oak Ridge

Linear Accelerator (ORELA) was used to provide the neutrons, and a NaI spectrometer, to detect the gamma rays at 125°. The data presented are the double differential cross section, $d^2\sigma/d\Omega\, dE_\gamma$ for gamma-ray energies between 0.3 and 10.6 MeV for coarse intervals in incident neutron energy. The integrated yield of gamma rays of energies greater than 300 keV and higher resolution in the neutron energy is also presented. The experimental results are compared with the Evaluated Neutron Data Library (ENDL). (24 figures, 21 tables) (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

00860 (COO—2176-35) **Quantum numbers of low lying neutron resonances in U-235.** Felvinci, J.P.; Melkonian, E.; Havens, W.W. Jr. (Columbia Univ., New York (USA)). 1975. 4p. (CONF-750303—72). Dep. NTIS $4.00.

From Proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Experiments were performed at ORELA to measure the low energy fission cross section of ^{235}U. Times of flight of the neutrons causing fission and the fission fragment energy detected by a solid state detector were recorded event-by-event. Analysis of the data showed marked pulse height variation among resonances. Several of the large resonances were shown to be composites and the level density obtained is much higher than previously determined. The results were interpreted by the hypothesis that K is a good quantum number in the compound nucleus. This assumption and the systematic variation of the fission fragment energies among resonances enabled us to assign J and K quantum numbers to many levels. Three families of fission resonances were seen, $J = 4^-$; $K = 2$, $J = 4^-$; $K = 1$, and $J = 3^-$; $K = 1$. Our results have implications as to the accuracy of fission cross section measurements and to the calculation of cross sections in the unresolved energy region. (1 table, 2 figures) (auth)

00861 (UCRL—76548) **Excited quasiparticle states of odd-mass deformed nuclei in the transplutonium elements.** Hoff, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Aug 1975. 22p. (CONF-750915—8). Dep. NTIS $4.25.

From 5. international conference on plutonium and other actinides; Baden-Baden, F.R. Germany (10 Sep 1975).

Experimental evidence is summarized from the published literature for excited single-particle configurations in the actinide-element deformed nuclei. Experimental data is compared for the levels of ^{249}Bk and ^{245}Cm with two recent theoretical treatments, one calculation of pure single-particle levels and another in which interactions between single-particle and collective motions are included. In the latter half of the paper, new information is presented on ^{249}Bk levels from nuclear spectroscopic measurements of ^{253}Es alpha decay and ^{249}Cm beta decay performed at Lawrence Livermore Laboratory and Lawrence Berkeley Laboratory. (5 figures) (auth)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

00862 (COO—2176-36) **Evidence for structure in the sequence of S-wave levels in ^{239}U.** Melkonian, E.; Felvinci, J.P.; Havens, W.W. Jr. (Columbia Univ., New York (USA)). 1975. 2p. (CONF-750303—71). Dep. NTIS $4.00.

From Proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The levels in ^{239}U show unusual clusterings of large and small levels as evidenced by runs statistics and sequential correlation of values of GAMMAn°. Also, GAMMAn° is found to show significant correlation with GAMMA/sub γ/. These effects are interpreted in terms of a model which assumes that excitation states are built upon persistent states of collective vibration and that an entering neutron seeks to form those states involving minimum change of particle motion. (2 figures) (auth)

NUCLEAR REACTIONS AND SCATTERING

00863 (ANL—8153, pp 33-56) **Nuclear fission and reactions.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

The nuclear fission research programs are designed to elucidate basic features of the fission process. Specifically, (1) factors determining how nucleons of a fissioning nucleus are distributed between two fission fragments, (2) factors determining kinetic energy and excitation energies of fragments, and (3) factors controlling fission lifetimes. To these ends, fission studies are reported for several heavy elements and include investigations of spontaneous and neutron-induced fission, heavy ion reactions, and high energy proton reactions. The status of theoretical research is also discussed. (SDF)

00864 (COO—2479-5) **Precision neutron cross section measurements in support of the LMFBR program. Annual progress report, 1 July 1974—30 June 1975.** Block, R.C.; Hockenbury, R.W. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). Apr 1975. Contract AT(11-1)-2479. 7p. Dep. NTIS $4.00.

Brief summaries are presented for the following: precision neutron cross section measurements in support of the LMFBR program; sodium total cross sections in the minima, iron filtered beam measurements; a personnel summary. A list of reports issued during the period is appended. (SDF)

00865 (COO—3496-50, pp 11-16) **Collective states populated by inelastic deuteron scattering on even—even actinide nuclei.** Thompson, R.C. (Univ., Frankfurt am Main); Huizenga, J.R.; Elze, T.W.; Unik, J.P. 1975.

Studies of nuclear fission, low energy nuclear reactions and transuranic nuclei. Progress report, 1 June 1974—1 June 1975.

00866 (COO—3496-50, pp 17-24) **Inelastic deuteron scattering from odd-A actinide nuclei.** Thompson, R.C. (Univ. Frankfurt am Main); Huizenga, J.R.; Elze, T.W.; Unik, J.P. 1975.

Studies of nuclear fission, low energy nuclear reactions and transuranic nuclei. Progress report, 1 June 1974—1 June 1975.

00867 (COO—3496-50, pp 25-27) **Study of the ^{234}U(d,t)^{233}U reaction.** Johnson, W.; Thompson, R.C.; Huizenga, J.R. 1975.

Studies of nuclear fission, low energy nuclear reactions and transuranic nuclei. Progress report, 1 June 1974—1 June 1975.

00868 (COO—3496-50, pp 28-29) **Study of the levels in ^{236}Np and ^{238}Np by the ^{237}Np(d,t) and ^{237}Np(d,p) reactions.** Thompson, R.C.; Huizenga, J.R. 1975.

Studies of nuclear fission, low energy nuclear reactions and transuranic nuclei. Progress report, 1 June 1974—1 June 1975.

00869 (COO—3496-50, pp 30-34) **Nuclear levels of ^{238}Np excited by the (^{3}He,d) and (α,t) reactions.** von Egidy, T. (Univ., Munich); Elze, T.W.; Huizenga, J.R. 1975.

Studies of nuclear fission, low-energy nuclear reactions and transuranic nuclei. Progress report, 1 June 1974—1 June 1975.

00870 (COO—3496-50, pp 69-80) **Heavy ion total reaction cross section systematics determined from elastic scattering.** Birkelund, J.R. (Univ., Marburg, Ger.); Huizenga, J.R.; Freiesleben, H.; Wolf, K.L.; Unik, J.P.; Viola, V.E. 1975.

Studies of nuclear fission, low energy nuclear reactions and transuranic nuclei. Progress report, 1 June 1974—1 June 1975.

00871 (LBL—3887) **Shape isomer excitation by mu-minus capture.** Kaplan, S.N.; Monard, J.A.; Nagamiya, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. 14p. (CONF-750631—10). Dep. NTIS $4.00.

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

In a search for back-decay gamma rays from the shape isomer in ^{238}U following mu-minus capture, no candidates have been found with yields greater than 2 percent of the muon stoppings. The intensities of the gamma rays are insufficient to permit definitive lifetime measurements of individual peaks; however, for 500-keV energy ranges of gamma ray pulses, lifetimes have been determined that give results consistent with recent electron lifetime measurements. (6 figures, 2 tables) (auth)

00872 (ORNL—5025, pp 36-37) **Transfer and compound-nucleus reactions that lead to the nuclei ^{245}Cf and ^{244}Cf: interactions of ^{12}C with ^{239}Pu and ^{238}U.** Hahn, R.L.; Dittner, P.F.; Toth, K.S.; Keller, O.L. Jr. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

As part of a continuing program to study nuclear reaction mechanisms in actinide elements, the reactions ^{239}Pu(^{12}C,α 2n-

α3n) and ^{238}U(^{12}C,5n-6n) leading to ^{245}Cf and ^{244}Cf were studied by measuring excitation functions and recoil range and angular distributions. The results are consistent with models of transfer reactions in which an aggregate is transferred to the target nucleus from the projectile, followed by evaporation of neutrons from the resulting heavy nucleus. (1 figure) (SDF)

00873 (ORNL—5025, pp 60) **Attempted synthesis and identification of element 106.** Bemis, C.E. Jr.; Dittner, P.F.; Hensley, D.C.; Hahn, R.L.; Keller, O.L.; Tarrant, J.R.; Hunt, L.D. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

An attempt has been made to produce element 106 via the reaction ^{249}Cf(^{18}O,4n). Two new alpha groups were observed at 9.06 and 9.25 MeV having a half-life of 0.74 +- 0.23 sec which has been ascribed to the alpha decay of element 106. The results are consistent with a recently published report on the discovery of element 106. (1 figure) (SDF)

00874 (UCID—16841) **Transactinium nuclear cross section measurements at the LLL 100-MeV LINAC.** Browne, J. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jul 1975. 12p. Dep. NTIS $4.00.

The purpose of this report is to provide information to the Advisory Group Meeting on Transactinium Isotope Nuclear Data concerning recent results and plans for future work in this field at the Livermore 100-MeV linac. This meeting will be convened by the IAEA in cooperation with the OECD Nuclear Energy Agency at the Kernforschungszentrum Karlsruhe from 3 to 7 November 1975. In this report fission cross section ratios, ^{245}Cm fission cross section, and future plans for transplutonium measurements are discussed, and recommendations for other measurements are made. No data are given in this report. (RWR)

00875 (UCRL—77103) **Discovery of ^{250}Fm.** Hoffman, D.C.; Weber, J.; Wilhelmy, J.B.; Hulet, E.K.; Lougheed, R.W.; Landrum, J.H.; Wild, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Aug 1975. 6p. (CONF-750913—3). Dep. NTIS $4.00.

From 4. international transplutonium elements symposium; Baden-Baden, F.R. Germany (13 Sep 1975).

^{250}Fm, with the largest known neutron number (159) was synthesized by bombarding ^{257}Fm with 16-MeV tritons. The half-life and kinetic energy distribution of coincident fragments were measured. Fission properties of this isotope are significant in gauging the fission stability of a group of unknown isotopes extending from fermium to the postulated "island of stability" at ^{289}114. (2 figures) (SDF)

SPONTANEOUS AND INDUCED FISSION

00876 (BNWL-B—281) **Final report on ARPA fission yield project work at Battelle-Northwest, April 1970—April 1973.** Ballou, N.E.; Kaye, J.H.; Reeder, P.L.; Stoffels, J.J.; Anderl, R.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 75p. Dep. NTIS $6.75.

The overall objective has been to measure the independent and cumulative fission yields of selected halogen and rare gas nuclides for application to characterization of underground nuclear detonations. The studies have included fission yield measurements for thermal, fission spectrum, and 15 MeV neutron-induced fission events. Target materials included ^{235}U, ^{238}U and ^{239}Pu. The research effort was divided into two basic parts. In one part, the nuclides of interest were separated radiochemically and determined by gamma-ray spectrometry. This approach provides information on the independent and cumulative yields of nuclides with half-lives of a few seconds or greater. The second part of our effort involved the use of on-line mass separation techniques. This approach yields information on independent fission yields of nuclides with half-lives ranging down to fractions of a second and provides data on all significant isotopes of a given fission product element in one set of measurements. The main effort in the radiochemistry program was centered on measurements of the cumulative fission yield of ^{89}Kr. Cumulative fission yields of ^{89}Kr were measured for thermal-neutron fission of ^{239}Pu and for fission-spectrum and 15-MeV neutron fission of ^{235}U, ^{238}U and ^{239}Pu. In addition, cumulative fission yields of the other rare gas radionuclides, /sup 85m/Kr, ^{87}Kr, ^{88}Kr, ^{137}Xe, ^{138}Xe, were measured for the same fission type events. Fractional independent yields of ^{89}Rb and ^{136}Cs were also measured for a limited number of fission systems. On-line mass spectrometer facilities were established at a Van de Graaff accelerator and at a nuclear reactor. Measurements were made of relative independent fission yields of rubidium isotopes of masses 89 through 97 and of cesium isotopes of masses 139 through 145. Techniques for generation and measurement of negative ions of bromine and iodine fission product isotopes were developed and demonstrated. (23 tables, 6 figures) (auth)

00877 (CONF-750427—6) **^{238}U (n,f) measurements below 30 keV.** Slovacek, R.E.; Cramer, D.S.; Bean, E.B.; Hockenbury, R.W.; Valentine, J.R.; Block, R.C. (Knolls Atomic Power Lab., Schenectady, N.Y. (USA); Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). 1975. 16p. Dep. NTIS $4.00.

From Meeting of the American Physical Society; Washington, District of Columbia, USA (28 Apr 1974).

The ^{238}U (n,f) cross section has been measured from 3 eV to about 30 keV with the lead slowing down spectrometer at the RPI Linac. Four fission ionization chambers containing a total of about 0.8 gm of ^{238}U (4.1 ppm ^{235}U) were used for the measurements. The fission widths of the 6.67, 20.9, and the 36.8 eV resonances were measured as (10 +- 1), (58 +- 9), and (12 +- 2) nanoelectron-volts respectively. The fission cross section integrated over the two subthreshold groups at 720 and 1210 eV and the average fission cross section from 10 to 30 keV are in agreement with a previous time of flight measurement. The fission width at 6.67 eV is 20 times smaller than an upper limit set by the only reported measurement in this energy region; the fission widths obtained in the present investigation are consistent with the (30 +- 50) nanoelectronvolt average width previously obtained for the resonances between 37 and 327 eV in a time of flight measurement using a nuclear device. From the measured fission widths, the ^{238}U thermal fission cross section was determined to be 2.7 +- 0.3 μ barns. The resonance fission integral was also obtained from the data as 1.33 +- 0.15 mbarns for ^{238}U. (4 figures, 4 tables) (auth)

00878 (COO—2176-26) **Pulse height effects in the measurement of U-233 fission cross sections.** Felvinci, J.P.; Melkonian, E. (Columbia Univ., New York (USA). Div. of Nuclear Science and Engineering). 1974. 4p. (CONF-741017—37). Dep. NTIS $4.00.

From Meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

Partial fission cross sections were calculated for different energy cuts in the fission fragment distribution. Statistically significant differences exist between different cuts. Some levels previously assumed to be single were split into two or more structures. It was concluded that fission cross sections are sensitive to pulse height bias and that level parameters calculated from biased measurements (when not all fragments are detected) may be in error. (2 figures) (RWR)

00879 (COO—2176-40, pp 5-11) **Determination of fission fragment energy spectrum distortion in fission cross section measurements using ionization chambers.** Cohensedgh, F.; Felvinci, J.P.; Melkonian, E. 1975.

Neutron spectroscopy. Progress report, 1 July 1974—30 June 1975.

NUCLEAR THEORY

NUCLEAR STRUCTURE

00880 (CONF-750663—2) **Is there a universal relationship connecting all two-body effective interactions.** Schiffer, J.P. (Argonne National Lab., Ill. (USA); Chicago Univ., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 23p. Dep. NTIS $4.25.

From International topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975).

It is shown that it is possible to fit the two-body matrix element data from A = 8 to 208 with a single interaction. Calculated and observed matrix elements are given. (12 figures, 4 tables) (SDF)

00881 (COO—2171-47) **Aspects of statistical spectroscopy relevant to effective-interaction theory.** French, J.B. (Rochester Univ., N.Y. (USA). Dept. of Physics and Astronomy). 1975. 14p. (CONF-750663—4; UR—534). Dep. NTIS $4.00.

From International topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975).

The three aspects of statistical spectroscopy discussed in this paper are the information content of complex spectra: procedures for spectroscopy in huge model spaces, useful in effective-interaction theory; and practical ways of identifying and calculating measurable parameters of the effective Hamiltonian and other operators, and of comparing different effective Hamiltonians. (4 figures) (RWR)

00882 (COO—2171-53) **Nuclear structure theory. Annual technical progress report, 1 July 1974—30 June 1975.** French, J.B.; Koltun, D.S. (Rochester Univ., N.Y. (USA). Dept. of Physics and Astronomy). 1975. Contract AT(11-1)-2171. 12p. Dep. NTIS $4.00.

Progress during the past year is summarized for the following areas of nuclear structure and reaction theory: Meson interac-

tions with nucleons and nuclei, including inelastic scattering of pions, threenbody theories of scattering and absorption of pions by deuterons, and π-p bremsstrahlung. Theory of the effective interaction, including behavior of the expansion in orders of the reaction matrix. Statistical spectroscopy including fluctuations in energy levels and excitation strengths, and sum rules and strength distributions for various excitation processes, including single-nucleon transfer, β decay and multipole giant resonances. Studies of the inverse scattering problem. Studies of nuclear symmetries, of nuclear clustering, and of general nuclear structure by α-transfer reactions, and of nuclear shapes by (d,^{3}He) reactions. (auth)

00883 (ORNL—5025, pp 14-15) **Microscopic descriptions of giant multipole resonances.** Becker, R.L.; McGrory, J.B.; Halbert, E.C.; Satchler, G.R.; Speth, J. May 1975.

Physics Division annual progress report for the period ending December 31, 1974.

Giant multipole resonances have been studied in closed shell nuclei using random phase approximation methods. Results are shown for the inelastic scattering of protons by ^{208}Pb. Contributions from the various multipoles are considered, particularly the monopole oscillation. As an alternate approach, a shell model calculation has been performed for ^{16}O using Brueckner G matrix elements calculated from the Hamada-Johnston potential. Although this calculation does not lead to the observed excitation spectrum, it does lead to quadrupole and monopole states. (3 figures) (SDF)

00884 (ORO—4856-12) **Backbending in fast rotating nuclei and gapless superconductivity I qualitative considerations. Technical report No. 75-091.** Goswami, A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jun 1975. 22p. Dep. NTIS $4.25.

It is shown that the effect of coriolis antipairing on fast rotating nuclei leads to an intermediate phase of "gapless superconductivity" before the nuclei become "normal". The gapless excitations in this intermediate phase give rise to "crossing bands" that have been shown to be important for the explanation of backbending. A connection is thus established between the Mottelson—Valatin and the Stephens' approach to this problem. The mathematics of our theory is based on a self-consistent perturbation treatment of the pairing force within the context of the single particle equation of motion method. (auth)

NUCLEAR MATTER

00885 (COO—3001-119) **Abnormal states of nuclear matter.** Castillejo, L. (State Univ. of New York, Stony Brook (USA)). 1975. Contract AT(11-1)-3001. 13p. (CONF-750631—11). Dep. NTIS $4.00.

From 6. international conference on high energy physics and nuclear structure; Santa Fe, New Mexico, USA (9 Jun 1975).

Results for abnormal states in nuclear matter are reviewed and compared with π^- condensates in the context of chiral invariance and the sigma model. The relative importance of symmetry breaking and conserving interactions is assessed for the two problems. Vacuum self-energy effects are crucial in abnormal matter calculations particularly when finite size abnormal nuclei are considered. (7 figures) (auth)

NUCLEAR REACTIONS AND SCATTERING

00886 (COO—2130-163, pp 1-23) **Why should anyone study heavy-ion reactions.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

Two kinds of experiments that can be performed with heavy ions are discussed. The first is the population of high angular momentum states using the fact that the heavy ion brings in a lot of angular momentum, and the second is the study of states made up of multi-particle excitations. (LBS)

00887 (COO—2130-163, pp 133-152) **Point charged particles: Born and BEA approaches.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

The use of the binary encounter approximation in the computation of inner shell vacancy production is considered. Comparisons are made with Born approximation results. (10 figures) (SDF)

00888 (LBL—4203) **Fragmentation of relativistic nuclei.** Cork, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. Contract W-7405-eng-48. 29p. (CONF-750655—1). Dep. NTIS $4.50.

From 6. international conference on high energy physics and nuclear structure; Albuquerque, New Mexico, USA (8 Jun 1975).

Nuclei with energies of several GeV/n interact with hadrons and produce fragments that encompass the fields of nuclear physics, meson physics, and particle physics. Experimental results are now available to explore problems in nuclear physics such as the validity of the shell model to explain the momentum distribution of fragments, the contribution of giant dipole resonances to fragment production cross sections, the effective Coulomb barrier, and nuclear temperatures. A new approach to meson physics is possible by exploring the nucleon charge-exchange process. Particle physics problems are explored by measuring the energy and target dependence of isotope production cross sections, thus determining if limiting fragmentation and target factorization are valid, and measuring total cross sections to determine if the factorization relation, sigma/sub AB/^{2} = sigma/sub AA/ . sigma/sub BB/, is violated. Also, new experiments have been done to measure the angular distribution of fragments that could be explained as nuclear shock waves, and to explore for ultradense matter produced by very heavy ions incident on heavy atoms. (12 figures, 2 tables) (auth)

00889 (ORNL—5025, pp 17-19) **Multistep processes in direct reactions.** Rickertsen, L.D. May 1975.

Physics Division annual progress report for the period ending December 31, 1974.

The general reaction code CHUCK provides a solution for a set of simultaneous second order differential equations under the appropriate boundary conditions. Calculations using CHUCK are being made for inelastic scattering cross sections of ^{12}C on ^{144}Nd, ^{12}C on ^{12}C, and a study of the contribution from the (^{3}He,α), (α,t) two-step process to the angular distribution in (^{3}He,t) reactions. It is found that the distorting potentials in intermediate channels of the two-step process have a considerable influence on both the shape and magnitude of the final angular distributions. (1 figure) (SDF)

00890 (ORNL—5025, pp 19-20) **Nucleus—nucleus optical potentials.** Owen, L.W.; Satchler, G.R. May 1975.

Physics Division annual progress report for the period ending December 31, 1974.

The properties of the nucleus—nucleus optical potential that can be inferred from analysis of elastic scattering data are investigated. The study includes ORNL data from ^{11}B, ^{12}C, ^{16}O, and ^{20}Ne on ^{208}Pb; ^{12}C on ^{90}Zr; and ^{16}O on ^{58}Ni, ^{60}Ni, ^{60}Co, and ^{28}Si. Inelastic scattering and transfer reactions are also considered. Data and optical model fits using a folded real potential from a Gaussian nucleon—nucleon interaction and Woods-Saxon imaginary potential are presented for ^{16}O + ^{208}Pb. (1 figure) (SDF)

00891 (ORO—4856—14) **Reactive content of the single scattering optical potential.** Tandy, P.C.; Redish, E.F.; Bolle, D. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jun 1975. 11p. Dep. NTIS $4.00.

A unitarity relation is derived for the nucleon-nucleus scattering amplitude which displays the reaction mechanisms associated with the absorptive part of the single scattering optical potential. The reactions implicit in the absorption are nucleon pickup and knockout. The transition amplitudes for these processes are extracted from the unitarity relation and their accuracy is discussed. (auth)

00892 (ORO—4856-19) **Nonrelativistic hard-pion production and current-field algebra. II. Reactions with composite targets. Technical report No. 76-006.** Banerjee, M.K.; Levinson, C.A.; Shuster, M.D.; Zollman, D.A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jul 1975. 21p. Dep. NTIS $4.25.

Current-field algebra and mass dispersion relations are applied to the study ofion production in nucleon—nucleus collisions. The pion-production cross sections when only the pion is observed are shown to depend at threshold only on the target—projectile optical potential. The nature of the "hard"-pion corrections are examined in a nonrelativistic framework. (auth)

RADIOACTIVE DECAY

00893 (ORO—4856-18) **Variational principle for the Bloch unified reaction theory.** MacDonald, W.; Rapheal, R. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1975. 16p. Dep. NTIS $4.00.

The unified reaction theory formulated by Claude Bloch uses a boundary value operator to write the Schroedinger equation for a scattering state as an inhomogeneous equation over the interaction region. As suggested by Lane and Robson, this equation can be solved by using a matrix representation on any set which is complete over the interaction volume. Lane and Robson have proposed, however, that a variational form of the Bloch equation can be used to obtain a "best" value for the S-matrix when a

finite subset of this basis is used. The variational principle suggested by Lane and Robson, which gives a many-channel S-matrix different from the matrix solution on a finite basis, is considered first, and it is shown that the difference results from the fact that their variational principle is not, in fact, equivalent to the Bloch equation. Then a variational principle is presented which is fully equivalent to the Bloch form of the Schroedinger equation, and it is shown that the resulting S-matrix is the same as that obtained from the matrix solution of this equation. (auth)

SPONTANEOUS AND INDUCED FISSION

00894 (COO—2130-163, pp 305-328) **Coulomb-induced and triple fission.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

Aspects of heavy ion physics, including Coulomb fission, super-heavy elements, and triple fission are considered. (9 figures) (SDF)

00895 (ORO—4856-15) **Effects of rotation on the stability of nuclei under fission and the possibility of fusion in heavy-ion reactions.** Mustafa, M.G.; Kumar, K. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jun 1975. 33p. Dep. NTIS $4.75.

The two-center shell model for fission is extended to include the effects of nuclear rotation or angular momentum J. The principle of minimization of total nuclear energy with respect to a constraint on J leads to an effective potential energy which depends on J as well as moment of inertia. This effective potential energy is minimized with respect to nuclear shape variables, neutron pairing energy gap, and proton pairing energy gap for each J value. The resulting potential minima, fission barriers, and moments of inertia are quite sensitive to J. Results are given for $^{208}_{82}$Pb, $^{240}_{94}$Pu, and for a super-heavy nucleus, $^{288}_{114}$X. Microscopic calculations of the critical angular momentum (at which the fission barrier vanishes) are compared with the rotating liquid drop calculations of Cohen, Plasil, and Swiatecki. The influence of these results on the possibility of fusion in heavy-ion reactions is discussed. (5 figures, 6 tables) (auth)

NUCLEAR MODELS

00896 (COO—2130-163, pp 153-170) **Structure projectiles: theoretical modeling.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

A discussion of differences in production of inner shell vacancies for ions heavier than alpha particles compared to protons and alpha particles is presented. A theoretical account is given, and the problem of fluorescence yield is considered. (6 figures) (SDF)

00897 (COO—2130-163, pp 208-239) **Two-center shell model.** 1973.

Heavy ion lecture series, 1972—73, Volume II.

An asymptotically well behaved shell model is discussed mostly from the point of view of fission reactions. The model is basically of double oscillator nature with spin orbit and l^2 terms added. Various aspects including the mass distribution in asymmetric fission are discussed. (24 figs.) (SDF)

00898 (LA-UR—75-1305) **Perturbation theory of effective Hamiltonians.** Brandow, B.H. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 22p. (CONF-750663—3). Dep. NTIS $4.25.

From International topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975).

This paper constitutes a review of the many papers which have used perturbation theory to derive "effective" or "model" Hamiltonians. It begins with a brief review of nondegenerate and non-many-body perturbation theory, and then considers the degenerate but non-many-body problem in some detail. It turns out that the degenerate perturbation problem is not uniquely defined, but there are some practical criteria for choosing among the various possibilities. Finally, the literature dealing with the linked-cluster aspects of open-shell many-body systems is reviewed. (RWR)

00899 (ORNL—5025, pp 10-11) **Phenomenological self-consistent field model.** Cusson, R.Y.; Kolb, D. May 1975.

Physics Division annual progress report for the period ending December 31, 1974.

A new, more realistic reaction matrix model of the self-consistent field has been developed and applied to the calculation of single particle energies for ^{208}Pb. A new code has also been written to complement this improved model and provide for iterative computation of the self-consistent total energy within an input constraint (density asymmetry). Results for the ^{16}O + ^{208}Pb system are shown. (2 figures) (SDF)

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

00900 (COO—323-33) **Composition variability and equivalence of Shonka TE plastic.** Spokas, J.J. (Illinois Benedictine Coll., Lisle (USA). Physical Sciences Lab.). 1973. 17p. (CONF-750546—2). Dep. NTIS $4.00.

From Annual meeting of the Radiation Research Society; Miami, Florida, USA (12 May 1975).

A number of conducting plastic mixtures had been developed by Francis R. Shonka, and collaborators, in the Physical Sciences Laboratory of Illinois Benedictine College (formerly St. Procopius College). Several of these mixtures have been used widely in radiation research. In particular, a tissue-equivalent (muscle) formulation designated A-150 has been used extensively in the dosimetry, research and measurements of gamma, neutron and pion beams. Certain confusion has arisen concerning the composition of A-150. The definition of A-150 is reviewed and what is known of the composition is summarized. The equivalence of A-150 and ICRU "muscle" with respect to photons is discussed as a function of photon energy using the latest data on extra-nuclear photon cross sections. (auth)

00901 (COO—3150-25) **Observations on the determination of electron mean-free paths from rf size effect measurements.** Wagner, D.K.; Cochran, R. (Cornell Univ., Ithaca, N.Y. (USA). Lab. of Atomic and Solid State Physics). Jun 1974. Contract AT-(11-1)-3150. 13p. Dep. NTIS $4.00.

Numerical calculations of the line shape of the rf size effect for 0.1 mm thick potassium plates in the transmission geometry at 1.25 MHz show that the amplitude of the fundamental resonance is proportional to exp (-1.22d/l), while that of the second resonance is proportional to exp (-0.92d/l), where d and l are the plate thickness and electron mean-free path, respectively. In the case of the fundamental, the result differs significantly from the exp(-1.57d/l) dependence usually assumed for the purpose of determining l, and indicates that the conventional analysis leads to an overestimate of l by approximately 30 percent. The amplitude dependence found here can be explained physically in terms of the finite skin depth and, in the case of the second resonance, in terms of the strength of the electric field splash at the center of the plate. (4 figures) (auth)

00902 (ORO—2911-17) **Interaction of heavy ions with matter.** Boring, J.W.; Johnson, R.E. (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). Jun 1975. Contract AT(40-1)-2911. 73p. Dep. NTIS $6.75.

A description is given of work performed to describe the energy dependence of radiation damage by low energy heavy particles. Experimental work on inactivation cross sections for RNase with ions of less than 10 keV is covered and the models used for averaging the biological damage over the energy loss in the material are discussed. Data are presented on cross section measurements, primary recoils, and energy losses. 6 figs. (GHT)

00903 (SAND—75-0005) **Absolute determination of bremsstrahlung deposition (Hydra).** Lockwood, G.J.; Miller, G.H. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jun 1975. Contract AT(29-1)-789. 46p. Dep. NTIS $5.50.

A technique developed to measure electron energy deposition in metals has been applied to the determination of bremsstrahlung deposition. In this method a square-wave beam modulation is employed and the time-derivative of a calorimeter temperature is used to obtain the energy deposited. This paper presents the results of bremsstrahlung deposition measurements in gold and aluminum. Data are presented for dose to a material as a function of converter material, converter thickness, and angle of electron incidence for electron energies in the range from 0.2 to 1.0 MeV. In addition, measurements of dose as a function of calorimeter position as it was moved both laterally and axially with respect to the beam axis are reported. Utilizing the facility and technique developed to make these measurements, a thorough study of the bremsstrahlung measuring calorimeters used with the pulsed electron beam machine Hydra was accomplished. The goal of this study was to determine accurately the correction factor for the loading effect of the thermocouple wires. The loading correction factor was measured to be 1.72 with an uncertainty of +- 5 percent. This value should be used when determining true dose to gold with the standard Hydra calorimeters instead of the value of 1.5 obtained from data on Hydra, since there is a larger uncertainty in the latter value. (auth)

00904 **Applications of microdosimetry to models of cell survival. I.** Payne, M.G.; Garrett, W.R. (Oak Ridge National Lab., TN). *Radiat. Res.*; 63: No. 2, 201-210(Aug 1975).

The problem of incorporating track structure into cell survival models is discussed. We look at the track structure problem in terms of the primary particles (X rays, electrons, or heavy ions) imparting energy which shows up along the track and as electrons originating at the track with an energy and angular distribution characteristic of the type of primary particles. The ejected electrons and other electrons resulting from their collisions are then responsible for depositing energy at points off the primary particle path. We point out the possibility of separating the problem of energy transport away from the track by electrons from the problem of direct interaction of the primary particles. Possible collective effects are incorporated only crudely by adjusting the LET to fit experiment. Our discussion of track structure is closely related to previous work by Roesch and Glass. A cell survival model which is closely related to that of Roesch in the case of low LET radiation is developed for heavy ion, electron, or gamma radiation of arbitrary LET and is compared with the RBE theory of Kellerer and Rossi. Our cell survival models offers another possibility for dealing with survival data with heavy ions of varying type and energy. (auth)

MEDICAL PHYSICS

RADIATION PROTECTION STANDARDS

00905 (BNWL—1855) **Shielding calculational system for plutonium.** Zimmerman, M.G.; Thomsen, D.H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1975. Contract E(45-1)-1830. 87p. Dep. NTIS $5.45.

A computer calculational system has been developed and assembled specifically for calculating dose rates in AEC plutonium fabrication facilities. The system consists of two computer codes and all nuclear data necessary for calculation of neutron and gamma dose rates from plutonium. The codes include the multigroup version of the Battelle Monte Carlo code for solution of general neutron and gamma shielding problems and the PUSHLD code for solution of shielding problems where low energy gamma and x-rays are important. The nuclear data consists of built in neutron and gamma yields and spectra for various plutonium compounds, an automatic calculation of age effects and all cross-sections commonly used. Experimental correlations have been performed to verify portions of the calculational system. (23 tables, 7 figs, 16 refs) (auth)

DOSIMETRY

00906 (BNWL-SA—4813) **Dosimetry of the radioactive noble gases.** Soldat, J.K.; Bramson, P.E.; Parker, H.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 17p. (CONF-730915—17). Dep. NTIS $4.00.

From Symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

Methods are described that were used for estimations of the radiation dose rate to various human tissues from the radioactive gases of Ar, Kr, and Xe following inhalation or immersion in a semi-infinite cloud. Dose rates to the whole-body, lungs, adipose tissues, and testes were calculated following inhalation; and dose rates to the skin, whole-body, lungs, and testes from a semi-infinite cloud were calculated for ^{39}Ar, ^{41}Ar, ^{82}Kr, ^{85}Kr, ^{87}Kr, ^{88}Kr, ^{131}Xe, ^{133}Xe, ^{135}Xe, ^{137}Xe, ^{138}Xe, and also ^{85}Rb found in equilibrium with its parent ^{85}Kr and ^{135}Cs found in equilibrium with its parent ^{135}Xe. (CH)

00907 (CONF-720805—P1, pp 69-77) **Direct measurements of dose equivalent in aircraft.** Cowan, F.P.; Chester, J.D.; Kuehner, A.V.; Phillips, L.F. (Brookhaven National Lab., Upton, NY). 1972.

From 2. conference on natural radiation environment; Houston, Texas, USA (7 Aug 1972).

Natural radiation environment II.

Measurements were made of the radiation dose to passengers during air travel at various altitudes, geomagnetic latitude, and phase of the solar cycle in relation to travel time. Dosemeters and data computation methods used are described briefly. (CH)

SUPERCONDUCTIVITY

GENERAL THEORY

00908 (CALT—822-74) **On the critical temperature of superconductors.** Poon, S.J. (California Inst. of Tech., Pasadena (USA)). Jun 1975. Contract AT(04-3)-822. 33p. Dep. NTIS $4.75.

An exact expression for the superconducting transition temperature is derived from the Eliashberg equation at T = T/sub c/ taking the energy gap function in the two-square-well form. The expression is improved for self-consistency by using available tunneling data. It is found to give more restricted values of T/sub c/ than the McMillan equation. The prospects of obtaining high T/sub c/ in alloy systems are discussed within the framework of the new equation. (6 figures, 2 tables) (auth)

00909 (IS-M—37) **Phenomenological theory of the local magnetic field in Type-II superconductors.** Clem, J.R. (Ames Lab., Iowa (USA)). 1975. 4p. (CONF-750827—2). Dep. NTIS $4.00.

From Conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

Recent neutron diffraction experiments have yielded increasingly detailed information about the local magnetic field distribution in single-crystal flux-line lattices in type-II superconductors. Such experiments have shown that this field distribution is accurately represented by a linear superposition of the fields of isolated flux lines, provided the Ginzburg—Landau parameter, kappa, is large and the flux-line spacing is large compared with the coherence length. In this paper it is demonstrated that, within the framework of the Ginzburg—Landau theory, the procedure of obtaining the local magnetic field by a linear superposition of contributions of individual flux lines is valid for arbitrary kappa and flux-line spacings, provided these contributions are calculated using the correct spatially dependent magnitude of the order parameter that is appropriate for the given flux-line spacing; The field contribution of an individual flux line can be approximated with a simple model involving two parameters, a core radius parameter and a field-dependent penetration depth; this model, using only a single fitting parameter, lambda, gives a good semi-quantitative overall description of the neutron diffraction form factors and the corresponding magnetic field distribution in Nb at 4.2K. (1 figure) (RWR)

THEORETICAL PHYSICS

GENERAL AND MISCELLANEOUS

00910 (ORO—3992-217) **Structure of barnacled relativistic wave equations.** Khalil, M.A.K. (Texas Univ., Austin (USA). Center for Particle Theory). 31 Jul 1975. 44p. Dep. NTIS $5.25.

Manifestly Lorentz covariant wave equations of the form (β/sup μ/delta/sub μ/ + im) psi(x) = 0 are considered. It is shown that there are classes of such equations that reduce to simpler wave equations, derived from the original equation, in the free case. A subclass of these equations with reducible (beta ub μ) are called barnacled wave equations. Barnacled wave equations maintain their equivalence to the simpler equations in all interactions that are coupled through β/sub μ/ or its powers; as for example in a minimally coupled external electromagnetic field. Alternatively these equations introduce a new freedom in writing covariant wave equations that describe the same free physical system (and the same interacting system if interactions are coupled through the β/sub μ/). The structural properties of barnacled wave equations are considered in several contexts: a theorem is proven that allows both for the construction of all possible barnacled wave equations covariant under a given respresentation of SL(2,l), as well as determining whether or not a given equation can be brought to a barnacled form. It is shown that under certain conditions once a representation of SL(2,l) is specified, all equations covariant under the given representation must necessarily be barnacled. A complete classification scheme for barnacled wave equations is constructed. The necessary and sufficient conditions for a nonsingular Hermitizing matrix, eta, to exist for these wave equations are also found. Some formalism is also advanced, which makes it convenient to study general wave equations. (auth)

00911 (ORO—3992-226) **Regular perturbations in a vector space with indefinite metric.** Chiang, C.C. (Texas Univ., Austin (USA). Center for Particle Theory). Aug 1975. Contract AT(40-1)-3992. 18p. Dep. NTIS $4.00.

The Klein space is discussed in connection with practical applications. Some lemmas are presented which are to be used for the discussion of regular self-adjoint operators. The criteria for the regularity of perturbed operators are given. (JFP)

CONTROLLED THERMONUCLEAR RESEARCH

PLASMA RESEARCH

00912 (UCRL—76562) **Computer applications in controlled fusion research.** Killeen, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1975. 23p. (CONF-750808—1). Dep. NTIS $4.25.

From National topical meeting of the ANS on nuclear engineering education; University Park, Pennsylvania, USA (18 Aug 1975).

The role of Nuclear Engineering Education in the application of computers to controlled fusion research can be a very important one. In the near future the use of computers in the numerical modelling of fusion systems should increase substantially. A recent study group has identified five categories of computational models to study the physics of magnetically confined plasmas. A comparable number of types of models for engineering studies are called for. The development and application of computer codes to implement these models is a vital step in reaching the goal of fusion power. In order to meet the needs of the fusion program the National CTR Computer Center has been established at the Lawrence Livermore Laboratory. A large central computing facility is linked to smaller computing centers at each of the major CTR laboratories by a communications network. The crucial element that is needed for success is trained personnel. The number of people with knowledge of plasma science and engineering that are trained in numerical methods and computer science is quite small, and must be increased substantially in the next few years. Nuclear Engineering departments should encourage students to enter this field and provide the necessary courses and research programs in fusion computing. (auth)

PLASMA CONFINEMENT AND HEATING

00913 (BNL—20297) **Heavy ion space charge limits.** Maschke, A.W. (Brookhaven National Lab., Upton, N.Y. (USA)). 21 Jul 1975. 4p. Dep. NTIS $4.00.

Modern ultra-high vacuum technology makes it possible to accelerate and store heavy ions in low charge states. Such quasi-neutralized beams give rise to very high space charge limits in conventional charged particle storage rings and transport systems. In addition, the z^2 dependence of dE/dx gives rise to very short ranges for very high energies. Space charge limits are evaluated for a linear transport system, and it is shown that realistically achievable powers and energies are of interest for the ignition of thermonuclear pellets. (auth)

00914 (CONF-750905—5) **Extension of confinement and neutral injection experiments in ORMAK to higher parameters.** Lyon, J.F. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From 7. European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

The ORMAK operating regime was extended to higher toroidal fields (25 kG), higher discharge currents (200 kA), and higher injection power (500 kW), resulting in improved plasma parameters. Specifically, ion heating increases approximately linearly with coinjection power. For counterinjection, ion heating efficiency increases while fast ion loss and deleterious plasma perturbations decrease with increasing discharge current. (auth)

00915 (COO—2456-15) **Initial shock heating in a high beta belt pinch.** Taussig, R. (Columbia Univ., New York (USA)). Jun 1975. 4p. (CONF-750606—5). Dep. NTIS $4.00.

From 7. conference on numerical simulation of plasmas; New York, New York, USA (2 Jun 1975).

The first quarter cycle magnetic field compression of an elongated belt pinch is simulated with a one-dimensional, one fluid, two-temperature MHD code. The full anisotropic classical transport coefficients are used in order to predict accurately the ion and electron temperatures during initial shock heating of the plasma. The numerical scheme is a Lagrangian adaptation of the Hain-Roberts code with an additional iterative loop developed by Schneider to insure convergence when real transport properties are used. An external circuit equation, which includes a time varying inductance for the plasma, is coupled to the MHD code. The results of these simulations will provide realistic temperature and density profiles as input to equilibrium and stability analyses for the belt pinch. (auth)

00916 (MATT—1138) **System for rapid injection of metal atoms into plasmas.** Marmar, E.S.; Cecchi, J.L.; Cohen, S.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jul 1975. 24p. Dep. NTIS $4.25.

A system for producing 300 μs bursts of 10^{17} metal atoms with 3 eV average energy is described. It is shown that this system can be successfully used to introduce impurities into CTR oriented tokamaks for transport and confinement studies. (auth)

00917 (ORNL-TM—4941) **Research program for plasma confinement and heating in ELMO bumpy torus devices.** Dandl, R.A.; Dory, R.A.; Eason, H.O. (Oak Ridge National Lab., Tenn. (USA)). Jun 1975. Contract W-7405-eng-26. 155p. Dep. NTIS $10.75.

A sequence of experimental devices and related research activities which leads progressively toward an attractive full-scale reactor is described. The implementation of the steps in this sequence hinges on the development of microwave power sources, with high specific power levels, at millimeter wavelengths. Two proposed steps in this sequence are described. The first step proposed here, denoted EBT-S, requires increasing the EBT magnetic field to permit microwave heating at 18 and 28 GHz, as compared to the present 10.6 and 18-GHz configuration. A three-fold increase in plasma density, some increase in the temperatures, and an opportunity to test the validity of the transport models presently used to predict the plasma parameters are anticipated. This step will provide important operating experience with the 28-GHz power supplies, which are prototype tubes for millimeter sources at 120 GHz In the second step a new superconducting bumpy torus, EBT-II, would be fabricated to permit microwave heating at 90 and 120 GHz. This device would be designed to produce plasma densities and temperatures comparable to those of present-day tokamaks. This report reviews the experimental and theoretical research on EBT that has been carried out to date or formulated for the near future, and provides a status report as well as a research program plan. (auth)

00918 (ORO—4211-18) **Plasma heating and confinement. Progress report through June 1975.** (Tennessee Univ., Knoxville (USA)). 1975. 6p. Dep. NTIS $4.00.

The heating process in the hot-electron machine is discussed. The heating does not appear to be electron cyclotron resonance, but has many of the characteristics of parametric heating. A second set of observations concerns the operation of the plasma at much lower pressure in a simple mirror than is commonly considered possible (on the order of 10^{-6} torr). The expected flute instability apparently occurs late in the decay, about 50 msec after power turn-off. This is described in some detail. (MOW)

00919 (UCID—16851) **Two-component experiments in 2XIIB.** Logan, B.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Jul 1975. 41p. Dep. NTIS $5.25.

A design is presented for a gas feed to create a two-component (hot + cold) ion distribution in 2XIIB. Parameters for a radially uniform two-component plasma are estimated from a power balance between neutral beam injection and cold plasma end loss. The electron temperature is found to be beta limited rather than beam power limited, with the hot ion lifetime limited mainly by electron drag. (auth)

00920 (UCRL—76491) **Theoretical x-ray conversion efficiencies and spectra of single element plane targets heated by hundred picosecond light pulses from neodymium glass lasers.** Grasberger, W.H.; Violet, C.E.; Richards, L.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1975. 24p. (CONF-750427—5). Dep. NTIS $4.25.

From Meeting of the American Physical Society; Washington, District of Columbia, USA (28 Apr 1974).

A non-LTE rate equation computer program was combined with a program which simulates the heating of laser-heated targets in plane geometry. The hydrodynamic program calculates the absorption of laser light, the electron and ion temperatures--allowing for electron heat conduction--and the densities each time-step and feeds these values to the rate equation program. The rate equation program gives to the hydrodynamic program for each time-step a source-sink term for each hot zone above 20 eV, representing the net emission and adsorption of x rays. The calculations presented involve approximately ten hot and ten cool zones. (MOW)

00921 (UCRL—77221) **Recent mirror machine results and their implications for mirror systems.** Post, R.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Aug 1975. 11p. (CONF-750905—16). Dep. NTIS $4.00.

From 7. European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

Improved confinement recently achieved in the Livermore 2XIIB experiment is interpreted in terms of warm plasma stabilization of the drift-cone mode. The same theoretical model explains present and earlier mirror observations and also predicts improved prospects for achieving classical plasma loss rates in mirror fusion reactors. (auth)

00922 (UCRL—77255) **Recent experiments on the 2XIIB mirror machine.** Coensgen, F.H.; Cummins, W.F.; Logan, B.G.; Molvik, A.W.; Nexsen, W.E.; Simonen, T.C.; Stallard, B.W.; Turner, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Aug 1975. 9p. Dep. NTIS $4.00.

Plasma confinement experiments with neutral beam injection in the 2XIIB Magnetic mirror facility are described. Ion heating to 13 keV and build-up of hot ion densities to 4 x 10^{13} cm^{-3} are measured when streaming plasma is introduced to suppress microinstabilities. Increasing ion energy is found to increase n tau. (auth)

PLASMA DIAGNOSTICS

00923 (COO—2444-2) **Development of a beam probe diagnostic system for the United Aircraft "LITE" program. Final report, 1 April 1974—31 March 1975.** Stufflebeam, J.H.; Jennings, W.C.; Connor, K.A.; Hickok, R.L. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). Jul 1975. Contract AT(11-1)-2444. 62p. Dep. NTIS $6.25.

A heavy ion beam probe diagnostic system for the LITE plasma device has been designed, fabricated, tested and installed. The beam was aligned and slaved to the LITE magnetic field and the predicted defocusing of the beam was confirmed. A sophisticated Beam Trajectory Programmer to control the operation of the beam probe system was developed and placed into operation. The electrostatic energy analyzer detector system was installed and preliminary noise measurements were made. The system is now ready for final testing under full plasma operating conditions. (auth)

00924 (COO—2444-2) **Development of a beam probe diagnostic system for the United Aircraft "LITE" program. Final progress report, 1 April 1974—31 March 1975.** Stufflebeam, J.H.; Jennings, W.C.; Connor, K.A.; Hickok, R.L. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). Jul 1975. Contract AT(11-1)-2444. 62p. Dep. NTIS $6.25.

A heavy ion beam probe diagnostic system for the LITE plasma device was designed, fabricated, tested and installed. The beam was aligned and slaved to the LITE magnetic field and the predicted defocusing of the beam was confirmed. A sophisticated Beam Trajectory Programmer to control the operation of the beam probe system was developed and placed into operation. The electrostatic energy analyzer detector system was installed and preliminary noise measurements were made. The system is now ready for final testing under full plasma operating conditions. (auth)

00925 (LA-UR—75-864) **Stability and temperature measurements on ZT-1.** Baker, D.A.; Burkhardt, L.C.; Di Marco, J.N. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-750905—3). Dep. NTIS $4.00.

From 7. European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

Analysis of the magnetic field profiles set up in the ZT-1 pinched plasma demonstrated that the degradation of the stability of these profiles with time can be attributed to diffusion. Ion temperature measurements of Doppler broadened He II have determined its scaling over a range of both I/sub z/ and change in I/sub z/ with respect to time. (auth)

00926 (UCRL—76667) **Interferometric reconstruction of electron number densities in laser-induced plasmas.** Sweeney, D.W.; Attwood, D.T.; Coleman, L.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Aug 1975. 8p. (CONF-750801—3). Dep. NTIS $4.00.

From Topical meeting on image processing for 2-D and 3-D reconstruction from projections) theory and practice in medicine and the physical sciences; Stanford, California, USA (4 Aug 1975).

Holographic interferometry is used to reconstruct the electron number densities in a laser-induced plasma. The axisymmetric plasma field is reconstructed using a Fourier—Bessel series expansion technique. (auth)

PLASMA KINETICS - GENERAL

00927 (BNL-tr—609) **Experimental facility for determining plasma characteristics in ion sources.** Abroyan, M.A.; Kagan, Yu.M.; Kolokolov, N.B.; Lavrov, B.P. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1974. Translation by S.J. Amoretty of NIIEFA-D—0220. 29p. Dep. NTIS $4.50.

A facility for optical and electrical measurements of the plasma parameters in the arc plasma ion sources is described. The potentialities of the system are demonstrated on the basis of the electron concentration, the electron energy distribution function, and the radial population distribution of the excited states of hydrogen atoms in the arc plasma of the duoplasmatron. (auth)

PLASMA KINETICS - EXPERIMENTAL

00928 (CONF-750905—6) **Interaction of neutral hydrogen and plasma including wall reflection.** Clarke, J.F.; Sigmar, D.J. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From 7. European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

The kinetic equation for the neutral hydrogen in a hot plasma is solved by taking into account gas feed, Franck-Condon neutrals, wall absorption and re-emission of neutrals, electron impact ionization and charge exchange reactions. Steady state neutral profiles are obtained showing the effect of neutral hydrogen on the ion momentum and energy balance. (auth)

PLASMA KINETICS - THEORETICAL

00929 (CONF-750905—1) **Neoclassical equilibrium and transport calculations for the full range of collisionality.** Beasley, C.O.; McCune, J.E.; Meier, H.K.; van Rij, W.I.; Callen, J.D. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From 7. European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

The new Collisional Plasma Model, used to obtain neoclassical equilibria and transport in tori, is described. Results over the full collisionality range (banana through Pfirsch—Schlueter) show the distribution function, radial flux, bootstrap current and other important macroscopic quantities, and are compared with earlier, more approximate results. (auth)

00930 (COO—2059-47) **Integration of the Vlasov equation in configuration space.** Cheng, C.Z.; Knorr, G. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jun 1975. Contract AT(11-1)-2059. 52p. Dep. NTIS $5.75.

A convenient, fast, and accurate method of solving the one-dimensional Vlasov equation numerically in configuration space is described. It treats the convective terms in the x and v directions separately and produces a scheme of second order in Δt. The resulting free-streaming and accelerating equations are computed with Fourier interpolation and spline interpolation methods respectively. The numerical method is tested with linear and nonlinear problems. The method is very accurate and efficient. A new method of smoothing the distribution function is given. It reduces the computational effort by artificially increasing the entropy of the system. As a result, the distribution function is smooth enough to be well represented on a given mesh. The methods can be generalized in a straightforward way to deal with more complicated cases such as problems with nonperiodic spatial boundary conditions, two- and three-dimensional problems with and without external magnetic and/or electric fields. (auth)

00931 (COO—2276-6) **Annual progress report.** Russek, A. (Connecticut Univ., Storrs (USA). Dept. of Physics). Jun 1975. Contract AT(11-1)-2276. 4p. Dep. NTIS $4.00.

Progress has been made in calculation of cross-sections for dielectronic and radiative recombination when hot electrons are incident on partially stripped impurity ions. Calculations were completed for the cases of 1 keV and 10 keV electrons incident on ions of arbitrary Z with ionization state consistent with a 1 keV plasma temperature. It was found that dielectronic recombination dominates radiative recombination by a factor of 100 at 1 keV incident electron energy to a factor of 1000 at 10 keV incident electron energy. The work is now being extended to other plasma temperatures and is being improved by more accurate calculation of the matrix elements involved. Progress was also made in the calculation of accurate bremsstrahlung and higher order radiative processes which also occur when hot electrons are incident on partially stripped impurity ions. Formal expressions for the matrix elements have been obtained for cross-sections in a fully relativistic partial wave analysis for bremsstrahlung radiation both with and without electron excitation of the target ion. Final evaluation now awaits the evaluation of the relativistic radial integrals involved in these matrix elements. (auth)

00932 (COO—2456-12) **Time dependent computer simulation of an electromagnetic shock tube.** Chu, C.K. (Columbia Univ., New York (USA). Plasma Lab.). 1974. Contract AT(11-1)-3086. 6p. (CONF-750606—6). Dep. NTIS $4.00.

From 7. conference on numerical simulation of plasmas; New York, New York, USA (2 Jun 1975).

The high energy shock tube in the Columbia Plasma Physics Laboratory is an electromagnetically driven coaxial shock tube, designed to study shock-heated plasmas in regimes of fusion interest (ion temperature approximately 1 keV, shock speeds 4 x 10^8 cm/sec). The present paper summarizes the computational work devoted to this device. The purposes of these studies are (1) extending the theoretical understanding of the dynamics and physics of shock waves, particularly in more than one dimension, (2) anticipating and interpreting experimental results, and (3) determining parameters in the design of some experiments. (MOW)

00933 (COO—2456-13) **Class of unconditionally stable second-order implicit schemes for hyperbolic and parabolic equations.** Lui, H.C. (Columbia Univ., New York (USA). Plasma Lab.). [nd]. Contract AT(11-1)-2456. 4p. (CONF-750606—7). Dep. NTIS $4.00.

From 7. conference on numerical simulation of plasmas; New York, New York, USA (2 Jun 1975).

The linearized Burgers equation is considered as a model u/sub t/ tau/sub x/ = bu/sub xx/, where the subscripts t and x denote the derivatives of the function u with respect to time t and space x; a and b are constants (b greater than or equal to 0). Numerical schemes for solving the equation are described that are second-order accurate, unconditionally stable, and dissipative of higher order. (MOW)

00934 (COO—2456-14) **Numerical solution of the M.H.D. plasma equilibrium equation.** Reusch, M.F. (Columbia Univ., New York (USA)). Jun 1975. 2p. (CONF-750606—4). Dep. NTIS $4.00.

From 7. conference on numerical simulation of plasmas; New York, New York, USA (2 Jun 1975).

The solution of the plasma equilibrium equation has been the subject of past interest both as a necessary prerequisite for the study of plasma stability, and in itself for the maximization of certain desirable equilibrium properties. Most previous work has neglected an obvious consequence of the nonlinearity of the problem, namely bifurcation of the solutions. Bifurcation is the possibility of the existence of more than one or no solutions at all to the problem. A simple estimate of solution multiplicity and a method for obtaining it are given. (auth)

PLASMA PRODUCTION

00935 (COO—2007-59) **Laser-pellet fusion by energy feedback to a direct nuclear pumped auxiliary laser.** Wells, W.E. (Illinois Univ., Urbana (USA)). May 1975. 19p. (CONF-750531—7). Dep. NTIS $4.00.

From IEEE international conference on plasma science; Ann Arbor, Michigan, USA (14 May 1975).

A novel concept of new techniques which should expedite the design of a positive power reactor through an auxiliary laser system with excitation derived from reactions using neutrons from previous pellet implosions is described. Recently lasing has been achieved in radiation induced plasmas at two laboratories and indications of lasing or gain at two others in four different gas mixtures. The wavelengths of these lasers have ranged from 0.615μ to 3.5μ. These encouraging results have prompted the development of a simple analytic model which couples the present laser-fusion concepts to an auxiliary radiation-induced laser system. This model allows the compounding of laser energy through the use of the thermalized neutrons from the preceeding implosion. The model is discussed and the anticipated problems of such a scheme explored. The required characteristics of the external and auxiliary neutron pumped laser are also given. (auth)

00936 (SAND—75-0369) **Long focal-length telemicroscope for laser target alignment.** Cano, G.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jul 1975. Contract AT(29-1)-789. 15p. Dep. NTIS $4.00.

An inexpensive, long focal-length optical system was developed to view microscopic targets from large distances. Measured and theoretical limits of resolution agree within 2 percent at 560 nm. Spheres of diameter greater than or equal to 50 μm at 50 cm distance are clearly resolved. (auth)

00937 (UCRL—13640(App.)) **Laser fusion systems design study. Final technical report.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. 172p. Dep. NTIS $11.75.

Complete design specifications are given for the laser fusion research program. Data on the laser, lens system, target vidicons, alignment system, and the lens mount system are given. (MOW)

00938 (UCRL—51787) **Cylindrical laser targets.** Rinde, J.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Jun 1975. Contract W-7405-Eng-48. 8p. Dep. NTIS $4.00.

This report summarizes the work to date on cylindrical laser targets and describes the requirements, methods of preparation, and the results achieved on the initial prototypes. (auth)

00939 (UCRL—75979) **Acceleration of polyethelene foils by laser driven ablation.** Ahlstrom, H.G.; Burginyon, G.A.; Haas, R.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Oct 1974. 20p. (CONF-741079—17). Dep. NTIS $4.00.

From 16. annual meeting of the plasma physics division of the American Physical Society; Albuquerque, New Mexico, USA (28 Oct 1974).

The production of thermonuclear energy, by laser driven implosion of spherical DT shells, with achievable laser technology, requires the development of an efficient and stable implosion. Certain aspects of the acceleration of the spherical shells can be studied experimentally by irradiating thin, 5 to 25 μm, polyethelene foils. The results of foil acceleration experiments performed using a Nd:YAG-Glass laser capable of producing 150 J, 1 nsec pulses will be discussed. The dynamics of the accelerated foil, the ion blow off, high energy electron spectrum (6 to 180 keV), x-ray spectrum (1 to 150 keV) the spatial distribution of the x-ray emission, the laser beam focal spot energy distribution, the laser temporal pulse shape and spectrum for reflected and transmitted radiation have all been measured simultaneously. The results of these measurements are compared with detailed numerical simulations. (auth)

00940 (UCRL—76350) **Valkyrie, a CO_2 laser system for laser fusion experiments.** Manes, K.R.; Lindquist, W.B.; Renard, P.A.; Eddleman, H.E.; Smith, D.L.; Glaros, S.S.; Stewart, T.C.; Haas, R.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1975. 45p. (CONF-750520—10). Dep. NTIS $5.25.

From IEEE Optical Society of American conference on laser engineering and applications; Washington, District of Columbia, USA (28 May 1975).

A short-pulse CO_2 laser system fabricated from commercially available components for laser fusion experimentation is described. Simulation calculations are sketched, amplifier testing is discussed, overall laser system performance is reported and the requirements for a typical target irradiation experiment are described. (auth)

PLASMA INSTABILITIES

00941 (CONF-750905—4) **Results from the ELMO Bumpy Torus in a theoretical context.** Hedrick, C.L.; Dandl, R.A.; Dory, R.A.; Eason, H.O.; Guest, G.E.; Haste, G.R.; Ikegami, H.; Jaeger, E.F.; Lazar, N.H.; McAlees, D.G.; McNeill, D.H.; Nelson, D.B.; Owen, L.W. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From 7. European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

Theoretical and experimental results from the ELMO Bumpy Torus are discussed with particular emphasis on macroscopic stability and transport. (auth)

00942 (CONF-750905—8) **Neoclassical diffusion and dissipative trapped-electron instabilities in the transition from the banana to plateau collisionality regime.** Callen, J.D.; Tsang, K.T. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From 7. European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

A phenomenological procedure of separating velocity space into various regions of collisionality (banana, plateau, boundary layer), calculating the perturbed distribution functions accordingly, and appropriately averaging over velocity space, is used to analytically reproduce neoclassical diffusion and facilitate investigation of dissipative trapped-electron modes in this important transition regime. (auth)

00943 (CONF-750905—9) **Nonlinear evolution of MHD instabilities.** Bateman, G.; Hicks, H.R.; Wooten, J.W.; Dory, R.A. (Oak Ridge National Lab., Tenn. (USA)). 1975. 4p. Dep. NTIS $4.00.

From 7. European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

A 3-D nonlinear MHD computer code was used to study the time evolution of internal instabilities. Velocity vortex cells are observed to persist into the nonlinear evolution. Pressure and density profiles convect around these cells for a weak localized instability, or convect into the wall for a strong instability. (auth)

00944 (LA-UR—75-885) **Scyllac "derated" feedback sector experiments.** Cantrell, E.L.; Ellis, W.R.; Freeman, B.L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-750905—2). Dep. NTIS $4.00.

From 7. European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

A 120° sector of the Scyllac torus was "derated" for feedback stabilization experiments to reduce the m = 1 instability growth rates to values which are compatible with the response time of the feedback system. Initial plasma studies are given and compared with the predictions of an MHD model. Plasma stabilization experiments are reported. (auth)

00945 (LBL—3267) **Parametric instabilities in inhomogeneous plasma.** Nicholson, D.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 6 Jun 1975. Contract W-7405-ENG-48. 111p. Dep. NTIS $8.75.

Thesis.

The nonlinear coupling of three waves in a plasma is considered. One of the waves is assumed large and constant; its amplitude is the parameter of the parametric instability. The spatial-temporal evolution of the other two waves is treated theoretically, in one dimension, by analytic methods and by direct numerical integration of the basic equations. Various monotonic forms of inhomogeneity are considered; agreement with previous work is found and new results are established. Nonmonotonic inhomogeneities are considered, in the form of turbulence and, as a model problem, in the form of a simple sinusoidal modulation. Relatively small amounts of nonmonotonic inhomogeneity, in the presence of a linear density gradient, are found to destabilize the well-known convective saturation, absolute growth occurring instead. (auth)

00946 (MATT—1067) **Nonlinear coupling of kink modes in Tokamaks.** Dagazian, R.Y. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jul 1975. Contract AT(11-1)-3073. 62p. Dep. NTIS $6.25.

The m = 2, n = 1 kink mode is shown to be capable of destabilizing the m = 1, n = 1 internal kink. A nonlinear Lagrangian theory is developed for the coupling of modes of different pitch, and it is applied to the interaction of these modes. The coupling to the m = 2 mode provides sufficient additional destabilization to the internal mode to permit it to account even quantitatively (where it had failed when considered by itself) for many of the features of the disruptive instability. (auth)

00947 (MATT—1146) **Stabilization of trapped particle modes by reversed gradient profiles.** Tang, W.M.; Rutherford, P.H.; Furth, H.P.; Adam, J.C. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jul 1975. Contract AT(11-1)-3073. 15p. Dep. NTIS $4.00.

Under certain modes of operation of very large tokamaks such as the proposed TCT (Two-Component Torus), it is possible to create oppositely directed density and temperature gradients (nabla n . nabla T less than 0) in the hotter central region of the plasma and the usual profile (nabla n . nabla T greater than 0) on the colder outer edge. Such configurations are found to be very favorable to stability against trapped-particle modes. (auth)

00948 (ORNL-TM—5008) **Excitation of short wavelength Alfven oscillations by high energy ions in tokamak.** Beasley, C.O. Jr.; Lominadze, J.G.; Mikhailovskii, A.B. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 9p. Dep. NTIS $4.00.

The excitation of Alfven waves by fast untrapped ions in axisymmetric tokamaks is described by the dispersion relation epsilon$_{11}$ - c^{2}k/sub parallel bars/^{2}/ω^2 = 0. Using this relation a new class of instability connected with the excitation of Alfven oscillations is described. (MOW)

PLASMA WAVE PHENOMENA

00949 **Reflection and transmission of ion acoustic waves from a plasma discontinuity.** Gary, S.P. (Coll. of William and Marv, Williamsburg, VA); Alexeff, I.; Bloomberg, H.W. *IEEE (Inst. Electr. Electron. Eng.) Trans. Plasma Sci.*; PS-3: No. 2, 46-48(Jun 1975).

Transmission and reflection coefficients are calculated for an ion acoustic wave incident from the upstream direction upon a plasma discontinuity of width much less than the wavelength. In the limit of an infinitely strong discontinuity there is complete in phase reflection. (auth)

THERMONUCLEAR POWER PLANTS

00950 (COO—2218-09) **Summary of a meeting on non-electrical energy extraction from fusion reactors at AEC Germantown Headquarters, March 20, 1973.** Miley, G.H. (comp.). (Illinois Univ., Urbana (USA)). 20 Jul 1973. 35p. Dep. NTIS $4.75.

The following six topics were discussed at the meeting: (1) energy forms available from the plasma, (2) materials processing, (3) hydrogen production, (4) plasma chemistry/radiation processing, (5) coherent radiation/broad-band radiation, and (6) neutron applications. Summaries are given for each topic. (MOW)

00951 (COO—3028-18) **Studies in fusion reactor technology. Progress report, September 1, 1974—May 30, 1975.** Axtmann, R.C.; Perkins, H.K.; Kuehler, C.H.; Fish, J.D. (Princeton Univ., N.J. (USA). Dept. of Chemical Engineering). 1975. Contract AT(11-1)-3028. 7p. Dep. NTIS $4.00.

An H^+ ion accelerator for use in materials damage studies and radiolysis experiments has been placed into operation and tested from 5 to 40 kV. A target assembly for the accelerator has been designed and partially fabricated; a gas permeation apparatus which will be integrated with the target, is ready for assembly. A reaction vessel for radiolysis studies of hydrogen gas production from water vapor has also been assembled and tested. A new type of thin (less than 2000 A of aluminum) window, which will permit passage of H^+ ions from the accelerator to the reaction vessel, has been fabricated and tested at differential pressures as high as 100 torr. Thermal gas permeation studies indicate that at driving pressures between 10^{-4} and 10^{-2} torr and temperatures between 600-700°C, the permeation rate of hydrogen gas through stainless steel is proportional to the driving pressure. Previous studies (by others) at driving pressures greater than 0.1 torr display a dependence on the square root of the pressure. Molybdenum and tungsten coatings were found on samples cut from the ST Tokamak's inner vacuum wall by means of scanning electron microscopy and energy-dispersive x-ray analysis. (auth)

00952 (LA-UR—75-736) **Engineering concepts for laser-fusion reactor applications.** Booth, L.A.; Frank, T.G.; Finch, F.T. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 18p. (CONF-750812—2). Dep. NTIS $4.00.

From 10. intersociety energy conversion engineering conference; Newark, Delaware, USA (17 Aug 1975).

The long-range potential goal of the ERDA Laser Fusion Program is the production of commercial electric power. Although the scientific feasibility of significant thermonuclear energy release from laser imploded and heated pellets remains to be demonstrated, significant progress has been made toward this goal and many technological problems associated with ultimate applications of laser fusion are being investigated. Preliminary evaluations of several laser fusion reactor concepts have been made, and detailed studies of the most promising concepts, employing different methods for protecting structural components from damage by the products of fusion-pellet microexplosions, are being done. Engineering design and feasibility studies are also being done of other electric generating station subsystems. Overall economic and technology tradeoff studies are being done to assess the economic potential of various generating station concepts and to provide guidance for research and development programs. (auth)

PHYSICS AND BLANKET ENGINEERING

00953 (BNL—19565) **Preliminary reference design of a fusion reactor blanket exhibiting very low residual radioactivity.** Powell, J.R. (ed.). (Brookhaven National Lab., Upton, N.Y. (USA)). 1 Dec 1974. 114p. Dep. NTIS $8.75.

The following topics are described: (1) overview of the low activity blanket design, (2) plasma confinement, (3) fuel injection, (4) plasma heating, (5) mechanical features of the very low blanket and shield, (6) neutron activation and breeding, (7) blanket cooling, (8) electricity generation, (9) recovery of spent fuel and plasma exhaust, (10) recovery of bred tritium, (11) blanket replacement and processing, and (12) effluents during normal operation and emergency containment. (MOW)

00954 (BNL—20299) **Beryllium and lithium resource requirements for solid blanket designs for fusion reactors.** Powell, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). 31 Mar 1975. 16p. Dep. NTIS $4.00.

The lithium and beryllium requirements are analyzed for an economy of 10^6 MW(e) CTR[a] capacity using solid blanket fusion reactors. The total lithium inventory in fusion reactors is only approximately 0.2 percent of projected U. S. resources. The lithium inventory in the fusion reactors is almost entirely ^{6}Li, which must be extracted from natural lithium. Approximately 5 percent of natural lithium can be extracted as ^{6}Li. Thus the total feed of natural lithium required is approximately 20 times that actually used in fusion reactors, or approximately 4 percent of U. S. resources. Almost all of this feed is returned to the U. S. resource base after ^{6}Li is extracted, however. The beryllium requirements are on the order of 10 percent of projected U. S. resources. Further, the present cost of lithium and the cost of beryllium extraction could both be increased tenfold with only minor effects on CTR capital cost.

Such an increase should substantially multiply the economically recoverable resources of lithium and beryllium. It is concluded that there are no lithium or beryllium resource limitations preventing large-scale implementation of solid blanket fusion reactors. (auth)

00955 (ORNL-TM—4818) **Magnetohydrodynamics test of a one-sixth scale model of a CTR recirculating lithium blanket.** Young, F.J.; Holcomb, R.S.; Fraas, A.P. (Oak Ridge National Lab., Tenn. (USA)). Aug 1975. Contract W-7405-eng-26. 53p. Dep. NTIS $5.75.

A one-sixth scale model of an element of a recirculating lithium blanket for a fusion reactor was tested experimentally. The scale model was instrumented to measure flow, pressure drop and pumping power as functions of the applied magnetic field (0 to 4 T) and the pump current (0 to 300 amp dc). Reynolds numbers as high as 22,000, magnetic Reynolds numbers up to 0.047 and a maximum Hartmann number of 12,000 were obtained with a wall-to-fluid conductivity ratio of 0.0158. The ratio of loop pressure drop to fluid (NaK 44) velocity increased as a quadratic function of the magnetic field. The square term was dominant for the higher values of magnetic field and is predictable by simple laminar magnetohydrodynamic theory. For any given velocity and magnetic field the pressure drop in the field-flow-aligned legs of the loop is much greater than it would be in ordinary hydrodynamic flow, but nevertheless is more than an order of magnitude less than the pressure drop encountered when the fluid flows across the magnetic field. The pumping power was measured as a function of magnetic field and fluid velocity. For fields greater than 1 T and velocities exceeding 1 cm/sec the pumping power varied as the square of the product of the fluid velocity and the magnetic field. The measured value of the proportionality factor agrees with predictions based on certain simplifying assumptions. The extrapolation of these experimental results to a full scale recirculating lithium blanket indicates that no excessive pressure or pumping power is likely to result unless a drastic change in flow regime occurs as the MHD parameters are increased. There appears to be no reason to expect any such drastic change. (auth)

00956 **Fusion design study of nonmobile blankets with low lithium and tritium inventories.** Abdou, M.A. (Argonne National Lab., IL); Wittenberg, L.J.; Maynard, C.W. *Nucl. Technol.*; **26**: No. 4, 400-419(Aug 1975).

Developing a controlled thermonuclear reactor blanket that minimizes lithium and tritium inventories is feasible. The tritium inventory is minimized by keeping the lithium inventory to a minimum and utilization of a lithium-bearing compound with low retention for tritium and an efficient tritium extraction system. The lithium inventory is minimized by employing a thin layer of ^{6}Li operating in a soft neutron spectrum obtained by slowing down the deuterium-tritium (DT) neutrons in beryllium. Material properties and performance such as tritium retention, irradiation characteristics, and chemical compatibility of possible lithium-bearing materials and beryllium compounds have been evaluated. The blanket of the conceptual fusion reactor UWMAK-II uses stainless steel for first wall and structure, helium coolant, lithium aluminate enriched to 90 percent ^{6}Li for tritium breeding, metallic beryllium for neutron multiplication and moderation, and graphite for reflection and additional neutron moderation. A breeding ratio of 1.18 and nuclear heating of 18 MeV per DT neutron are obtained. The lithium inventory is only 4×10^4 kg (40 Mg). The steady-state inventory of tritium in the breeder is only 40 g, which is more than two orders of magnitude lower than that in blankets using lithium for cooling and neutron moderation as well as tritium breeding. Tritium leakage to the steam is kept to approximately 1 Ci/day by oxidation of the tritium in the helium coolant and absorption by a molecular sieve dessicant. Plant reliability is improved and accidental tritium and energy release are minimized in the type of blankets examined in this study. (auth)

MAGNET COILS AND FIELDS

00957 (BNL—16580) **Costs of magnets for large fusion power reactors: Phase I, cost of superconductors for dc magnets.** Powell, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). 25 Feb 1972. 283p. Dep. NTIS $17.25.

Projections are made for dc magnet conductor costs for large fusion power reactors. A mature fusion economy is assumed sometime after 2000 A. D. in which approximately 90,000 MW(e) of fusion reactors are constructed/year. State of the art critical current vs. field characteristics for superconductors are used in these projections. Present processing techniques are used as a basis for the design of large plants sized to produce approximately one-half of the conductor needed for the fusion magnets. Multifilamentary Nb-Ti, Pb-Bi in glass fiber, GE Nb_3Sn tape, Linde plasma sprayed Nb_3Sn tape, and V_3Ga tape superconductors are investigated, together with high purity aluminum cryoconductor. Conductor costs include processing costs [capital (equipment plus buildings), labor, and operating] and materials costs. Conductor costs are compared for two sets of material costs: current (1971 A. D.) costs, and projected (after 2000 A. D.) costs. (auth)

00958 (ORNL-TM—4958) **Calculation of magnetic fields from time-varying currents in the presence of conductors.** Dodd, C.V.; Deeds, W.E. (Oak Ridge National Lab., Tenn. (USA)). Jul 1975. Contract W-7405-eng-26. 40p. Dep. NTIS $5.00.

Equations were derived for the magnetic field for the case of a cylindrically symmetric coil of rectangular cross section being driven by a sinusoidal current above conducting plates. Computer programs were written to numerically evaluate these equations. The most general program calculates the field for a coil above multiple (up to 9) plates, each having any resistivity and thickness. The field is calculated anywhere in or behind the conductors, and for five different values of coil-to-conductor spacing. The total eddy-current power dissipated in the conductors is also calculated, as well as the magnetic field at the center of the coil. The calculations agree with calculations and experimental measurements performed by others, although only a few cases could be compared. Equations were also derived for the Fourier analysis of pulses, the power density, and the eddy-current force density; but no programs were written for these. (auth)

00959 (UCID—16821) **Transport of ion beams by magnetic fields on the beam edges.** Hooper, E.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jun 1975. Contract W-7405-Eng-48. 19p. Dep. NTIS $4.00.

The transport of low energy ion beams (less than 10 keV) by magnetic fields on the edge of the beam is analyzed. Calculations indicate that beams with low transverse temperature can be transported. (auth)

RADIATION HAZARDS

00960 (BNL—20241) **Production and use of Li(d,n) neutrons for simulation of radiation effects in fusion reactors.** Goland, A.N.; Gurinsky, D.H.; Hendrie, J.; Kukkonen, J.; Sheehan, T.; Snead, C.L. Jr. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 29p. (CONF-750723—3). Dep. NTIS $4.50.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

In the Brookhaven Accelerator-Based Neutron Generator 1.5-cm thick x 12-cm wide films of lithium flowing at the velocity of approximately 10 m sec^{-1} will be the targets for 30-MeV D^+ and D^- beams 1-cm high and 10-cm wide. At this energy a beam of energetic neutrons is emitted mainly in the forward direction (theta less than or equal to 20°) as a result of the Li(d,n) breakup reaction. Measurements of the neutron flux and spectrum as a function of incident deuteron energy and emission angle theta(theta less than or equal to 20°) indicate that the yield increases approximately linearly with increasing deuteron energy from 25 MeV to at least 35 MeV, and that the mean energy of the neutrons (theta = 0°) is about 0.4 of the incident deuteron energies between 25 and 35 MeV. The most probable neutron energy in the forward-directed (theta = 0°) spectrum is also about 0.4 of the deuteron energy over this range. For a 30-MeV beam, the full width at half maximum of the neutron spectrum is 11.8 MeV (theta = 0°), and the mean neutron energy is 13 MeV. Pertinent radiation-damage parameters were calculated for various materials exposed to this neutron spectrum. In Nb, for example, the helium production rate and the displacement rate simulate the values anticipated in a D-T fusion reactor spectrum of comparable flux. Furthermore, the primary-recoil-atom energy distributions produced by Li(d,n) neutrons in Al, Nb, and Au are similar to those produced by 14-MeV neutrons. (auth)

00961 (BNL—20263) **Preliminary design of a 30-MeV deuteron linear accelerator for the production of intense beams of high energy neutrons for CTR research.** Batchelor, K.; Blewett, J.P.; Chasman, R.; Claus, J.; Fewell, N.; Grand, P.; Lankshear, R.; Sheehan, J.; Witkover, R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. 23p. (CONF-750723—4). Dep. NTIS $4.25.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

A deuteron linear accelerator capable of accelerating continuous 100 mA beam currents to an energy of 30 MeV and producing high energy neutrons via deuteron breakup on a liquid lithium target will be described. The facility will contain two 500-kV injectors providing D^+ and D^- beams allowing the operation of two experimental targets simultaneously. The D^+D^- beams will originate from low-emittance duoplasmatron sources, be first accelerated in single or double-gap electrostatic 500-kV accelerators,

then injected into the linear accelerator for acceleration to 30 MeV. The 30-MeV linac is a drift-tube structure operating at 50 MHz and divided into eight cavities which will give the possibility to vary the final deuteron energy between 10 and 30 MeV. The deuteron beams will be transported to the targets in a 60-meter long channel designed to control the beam delivery on the target as to time structure, spot size, etc. The beam will be stopped on a flowing liquid-lithium target capable of removing the 3 megawatts of beam power produced. The target-neutron source parameters are described in the complementary paper titled: "Production and Use of Li(d,n) Neutrons for Simulation of Radiation Effects in Fusion Reactors," by A. Goland, et al. (auth)

00962 (LA—6032-MS) **LTPF: a linear theta-pinch neutron source.** Ellis, W.R. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1975. 44p. Dep. NTIS $4.00.

The linear theta pinch is optimized with respect to maximum neutron current on a sample located between the discharge tube and the compression coil wall. Emphasis throughout is placed on physics and technology considerations which govern the choice of parameters. Technological demands are (hopefully) kept to a minimum. Two "point designs" are developed which are distinguished by their compressional magnetic field (i.e., coil current) wave-forms: one is sinusoidal and continuous, the other trapezoidal and pulsed intermittently. Both point designs give an average neutron current of approximately 5 x 10^{12} n/cm^2/s. Both devices are characterized by short lengths (approximately 1 m), rapid cycling (2 to 30 kHz), and magnetic mirrors (2 to 5:1) at the ends. A crucial item is the power supply, which is discussed in detail. (auth)

00963 (ORNL—5025, pp 230-234) **High-intensity neutron source.** Saltmarsh, M.J.; Smith, G.J. May 1975.

Physics Division annual progress report for period ending December 31, 1974.

A d + Be neutron source (2 x 10^{12} neutrons cm^{-2} sec^{-1}) is described. Foil dosimetry and time-of-flight measurements were made to characterize the high-energy portions (E/sub n/ equal to or greater than 1 MeV) of the neutron beam, and samples were irradiated up to fluences of 2 x 10^{17} neutrons/cm^2. The experimental facility is described. (MOW)

00964 (SAND—75-5537) **Target irradiation studies using relativistic electron beams.** Clauser, M.J.; Freeman, J.R.; Hadley, G.R.; Halbleib, J.A.; Kelly, J.G.; Kuswa, G.W.; Miller, P.A.; Mix, L.P.; Perry, F.C.; Poukey, J.W.; Shope, S.L.; Swain, D.W.; Toepfer, A.J.; VanDevender, W.H.; Widner, M.M.; Wright, T.P.; Yonas, G.; Chang, J. (Sandia Labs., Livermore, Calif. (USA)). 1975. 7p. (CONF-750905—7). Dep. NTIS $4.00.

From 7. European conference on controlled fusion and plasma physics; Lausanne, Switzerland (1 Sep 1975).

Recent experiments are discussed in which hemispherical and spherical, high density targets were irradiated using a single relativistic electron beam. It is found that a substantial portion of the beam energy is incident on the target and that the deposition symmetry is, in some cases, quite uniform. (auth)

00965 (UCRL—51749) **Studies of radiation blistering effects on voltage holding.** Miley, G.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Mar 1975. Contract W-7405-Eng-48. 44p. Dep. NTIS $4.00.

The surfaces of niobium and tungsten wires were blistered by 300-keV helium-ion irradiation and then tested for voltage holding. A cylindrical projection-tube technique was employed so that regions of strong electron emission could be observed and later examined with a scanning electron microscope (SEM). Blistering was found to cause significant increases in pre-breakdown currents. However, these currents tend to saturate over a region corresponding to around 200-400 kV/cm surface field such that the ultimate voltage breakdown limit is not seriously reduced. Emission image observations and SEM photographs suggest that, in many cases, parts of the blistered surface are gradually erected by the strong surface fields, but this may not occur until after several arc breakdowns. SEM photographs also indicate that vapor from the anode may play an important part in the breakdown mechanism. Implications of these results to the design of devices important to fusion development, such as direct collectors and ion sources, are briefly discussed. The importance of future in situ irradiation-voltage experiments is also stressed. (auth)

00966 (UCRL—76896) **Repetitively pulsed material testing facility.** Zucker, O.; Bostick, W.; Gullickson, R; Long, J.; Luce, J.; Sahlin, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Aug 1975. 20p. (CONF-750518—3). Dep. NTIS $4.00.

From 3. European IRPA congress; Amsterdam, Netherlands (13 May 1975).

A continuously operated, 1 pps, dense-plasma-focus device capable of delivering a minimum of 10^{15} neutrons per pulse for material testing purposes is described. Moderate scaling from existing results is sufficient to provide 2 x 10^{15} n/cm^2.s to a suitable target. The average power consumption, which has become a major issue as a result of the energy crisis, is analyzed with respect to other plasma devices and is shown to be highly favorable. A novel approach to the capacitor bank and switch design allowing repetitive operation is discussed. (auth)

00967 (ERDA-tr—50) **Chemical atomization of graphite by H^+ ions.** Busharov, I.P.; Gorbatov, E.A.; Gusev, V.M.; Guseva, M.I.; Martynenko, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. Translation of Khimicheskoe raspylenie grafita ionami H^+. 10p. Dep. NTIS $4.00.

A simple model of the mechanism of chemical atomization is given, on whose basis a decrease in chemical atomization is qualitatively predicted for high temperatures. Mass spectrometric investigations of the atomization products cited, which found CH_4 and CH_3 molecules during the irradiation of graphite and H^+ ions thereby confirmed the presence of chemical atomization. A relationship of S and temperature of graphite T during irradiation was obtained which showed a decrease in the coefficient of atomization of a high temperature. (MOW)

COMPONENT DEVELOPMENT AND TESTING

00968 (ANL—8153, pp 165-174) **Basic studies in the development of controlled fusion.** Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

Summaries of research are given for the following topics: (1) spectroscopy of relevant high temperature systems, (2) matrix-isolation spectroscopy applied to quantitative sputtering studies of niobium, (3) spectroscopic characterization of sputtered molybdenum atoms isolated in rare-gas matrices, (4) synthesis and characterization of dinitrogen complexes of niobium and platinum in noble-gas matrices, (5) dinitrogen complexes of platinum, (6) synthesis and characterization of dibenzene-metal sandwich compounds in argon matrices at 14°K, and (7) investigation of metal hydrides by neutron scattering. (MOW)

00969 (BNL—20159) **Proposal for an accelerator-based neutron generator.** Grand, P. (ed.). (Brookhaven National Lab., Upton, N.Y. (USA)). Jul 1975. 160p. Dep. NTIS $11.00.

An Accelerator-based Neutron Generator is described that consists of a 30-MeV deuteron linear accelerator using a flowing liquid lithium target. With a continuous deuteron current of 100 milliamperes, a source intensity of more than 10^{16} neutrons per second will be produced. The neutrons will be emitted in a roughly collimated beam. The proposed facility can be divided into two areas: the 30-MeV linear accelerator and the multiple-target experimental area. The 30-MeV accelerator will consist of eight rf accelerating cavities in a single vacuum tank, each cavity being powered by its own rf power amplifier operating at 50 MHz. To shield the beam bunches from the rf field when it is in the decelerating direction, 66 "drift tubes" will be included; the drift-tube structures will include quadrupole magnets which will keep the beam focused. The accelerator will produce a continuous beam of 100 milliamperes. Beam power will thus be 3.0 megawatts; total power including rf losses in the accelerating cavities will be 4.5 megawatts. The injectors for the linear accelerator will be two 500-kV dc accelerators, one for injection of D^+ ions and the other for D^- ions. They can be used simultaneously or one can serve as a spare in case of breakdown or maintenance of the other. (MOW)

00970 (CONF-750718—1) **ISX tokamak as a radiation test facility for surface studies.** Colchin, R.J.; Jernigan, T.C.; Schaffer, M.J. (Oak Ridge National Lab., Tenn. (USA); General Atomic Co., San Diego, Calif. (USA)). 30 Jun 1975. 16p. Dep. NTIS $4.00.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

ISX (Impurities Study Experiment) is a moderate-sized tokamak facility dedicated to the study of the origin and transport of impurities. This machine is expected to approximate the plasma conditions in the outer layer of a large ohmically heated device, except for neutron effects. The deposition of impurities and limiter material from the walls will be studied by using AES, SIMS, and soft x-ray appearance potential spectroscopy. Chemical reactions with atomic hydrogen, as well as desorption by electrons, ions, and uv radiation, will be studied to determine the evolution of wall material into the plasma. UV spectroscopic and x-ray methods will be used to determine impurity-plasma transport. ISX is designed so that liners may be interchanged easily and quickly. This allows for

testing different wall and limiter materials, such as honeycomb walls, with a turnaround of a few weeks. Initial tests will determine the effectiveness of baking and discharge cleaning in attaining clean surfaces. The parameters of the machine are: r = 25 cm, R = 90 cm, B/sub T/ = 18 kG, and I/sub p/ = 150 kA for q = 4. Expected plasma parameters are T/sub e/ = 500 to 1000 eV, T/sub i/ = 300 to 500 eV, and n/sub e/ = 2 to 7 x 10^{13} cm^{-3}. (auth)

00971 (CONF-750723—9) **Large-volume intense neutron source for CTR materials studies.** Saltmarsh, M.J.; Horak, J.A. (Oak Ridge National Lab., Tenn. (USA)). 1975. 19p. Dep. NTIS $4.00.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

The measurement of bulk radiation effects for the CTR program will require the irradiation of many hundreds of samples by energetic neutrons to fluences in excess of 10^{21} n/cm^2. The environment of the samples must be well controlled, particularly as regards temperature and stress. There must be easy access for instrumentation and remote handling, and provision for pulsed operation may be required. A facility based on a 30 to 40 MeV 100 mA deuteron linac and a liquid lithium jet target appears to offer the best combination of intensity, experimental volume, energy spectrum and experimental access. The linear accelerator would be of the Alvarez type designed for high transmission efficiency and reliability and to take advantage of existing high power rf technology. The injector would be based on the Oak Ridge work with high current dc ion sources. Existing liquid metal technology appears adequate for the target design. (auth)

00972 (LA-UR—75-1032) **Electrical breakdown and tracking characteristics of pulsed high voltages in cryogenic helium and nitrogen.** Haarman, R.A.; Williamson, K.D. Jr. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-ENG-36. 16p. (CONF-750716—7). Dep. NTIS $4.00.

From International cryogenic materials conference; Kingston, Ontario, Canada (22 Jul 1975).

The proposed Scyllac Fusion Test Reactor (SFTR) at the Los Alamos Scientific Laboratory (LASL) anticipates using superconducting coils as the main energy storage device and will store a total energy of 400 MJ. The SFTR will operate in a pulsed mode with the superconducting energy storage system—METS (Magnetic Energy Transfer System)—experiencing a 60 kV pulsed voltage during each pulsed operation. This paper presents experimental data for use by engineers in the design of cryogenic apparatus that will be subject to the SFTR 60 kV pulsed waveform. Various electrode configurations were used in order to provide the designer with the most commonly used geometries over the widest practical range of helium and nitrogen temperatures from liquid to room temperature at pressures of 0.9 and 1.6 atm. Data are also presented on voltage tracking characteristics of Mylar, phenolic, polyethlene, nylon, teflon, and permali, which are commonly used structural dielectric materials. (auth)

00973 (LA-UR—75-1232) **Capacitor requirements for controlled thermonuclear experiments and reactors.** Boicourt, G.P.; Hoffman, P.S. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 21p. (CONF-750723—5). Dep. NTIS $4.25.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

Future controlled thermonuclear experiments as well as controlled thermonuclear reactors will require substantial numbers of capacitors. The demands on these units are likely to be quite severe and quite different from the normal demands placed on either present energy storage capacitors or present power factor correction capacitors. It is unlikely that these two types will suffice for all necessary Controlled Thermonuclear Research (CTR) applications. The types of capacitors required for the various CTR operating conditions are enumerated. Factors that influence the life, cost and operating abilities of these types of capacitors are discussed. The problems of capacitors in a radiation environment are considered. Areas are defined where future research is needed. Some directions that this research should take are suggested. (auth)

00974 (LA-UR—75-1247) **LTPF: a linear theta-pinch neutron source.** Ellis, W.R. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 46p. (CONF-750723—7). Dep. NTIS $5.50.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

The linear theta pinch is optimized with respect to maximum neutron current on a sample located between the discharge tube and the compression coil wall. Emphasis throughout is placed on physics and technology considerations which govern the choice of parameters. Technological demands are (hopefully) kept to a minimum. Two "point designs" are developed which are distinguished by their compressional magnetic field (i.e., coil current) waveforms: one is sinusoidal and continuous, the other trapezoidal and pulsed intermittently. Both point designs give an average neutron current of approximately 5 x 10^{13} $n/cm^2/s$. Both devices are characterized by short lengths (approximately 1 m), rapid cycling (2 to 30 kHz), and magnetic mirrors (2 to 5:1) at the ends. A crucial item is the power supply, which is discussed in detail. (auth)

00975 (LA-UR—75-1262) **Intense neutron source facility for the fusion energy program.** Armstrong, D.D.; Emigh, C.R.; Meier, K.L.; Meyer, E.A.; Schneider, J.D. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-eng-36. 51p. (CONF-750723—8). Dep. NTIS $5.75.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

The intense neutron source is based on the ability of a supersonic flow of gas to dissipate an enormous quantity of heat generated in the neutron-producing target by multiple Coulomb collisions. A description is given of the principles involved in forming the supersonic jet, in forming the intense tritium-ion beam, in the vacuum systems, and in the tritium handling systems. An overview of the entire facility is included. It is believed that the facility can be operated with high reliability, ensuring a productive radiation damage program. (MOW)

00976 (SAND—75-5442) **Pulsed neutron sources for fusion reactor materials studies.** Teopfer, A.J.; Martin, T.H.; Clauser, M.J.; Swain, D.W.; Beckner, E.H. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1975. 18p. (CONF-750723—2). Dep. NTIS $4.00.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

Pulsed neutron sources for fusion reactor materials studies which use intense D_3 ion beams to irradiated tritiated targets, and intense relativistic electron beams to implode DT filled targets to thermonuclear burn are described. In present accelerators, high current ion beams are produced by space-charge limited emission from the anode plasma in vacuum diodes. Using deuterated electrodes, greater than 10^9, neutrons (2.5 MeV) have been produced from the D(d,n)He^3 reaction, without optimization of the diodes for ion beam production on a 400 kV, 8 kJ (5 x 10^{10} W) accelerator. The use of diodes designed to enhance the fraction of energy carried by the ion beam, and utilizing microsecond-pulse diodes, could lead to at least an order of magnitude enhancement in the neutron yield. With no enhancement, scaling of present results to a 10^{13} W accelerator operating at 1.5 MV with tritiated electrodes, results in estimated neutron yields greater than 10^{12} n/pulse in the 1976 to 1977 time frame. The use of intense relativistic electron beams to ignite inertially confined thermonuclear fuel will produce approximately 10^{13} n/pulse with beams generated from a 4 x 10^{13} W accelerator in 1980 to 1981. A substantial gain in output to approximately 10^{17} n/pulse should be available in the CY 1983 time frame from a projected 10^{14}W accelerator. (auth)

00977 (SAND—75-5772) **Large area solid target neutron source.** Crawford, J.C.; Bauer, W. (Sandia Labs., Albuquerque, N.Mex. (USA); Sandia Labs., Livermore, Calif. (USA)). 1974. 22p. (CONF-750723—10). Dep. NTIS $4.25.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

A potentially useful neutron source may result from the combination of a solid deuterium-tritium loaded target with the large area, high energy ion beams from ion sources being developed for neutral beam injection. The resulting neutron source would have a large radiating area and thus produce the sizable experimental volume necessary for future studies of bulk and synergistic surface radiation effects as well as experiments on engineering samples and small components. With a 200 keV D^+ T^+ beam and 40 kW/cm^2 power dissipation on a 200 cm^2 target spot, a total neutron yield of about 4 x 10^{15} n/sec may be achieved. Although the useable neutron flux from this source is limited to 1 to 2 x 10^{13} $n/cm^2/sec$, this flux can be produced 3 cm in front of the target and over about 300 cm^2 of experimental volume. Problems of total power dissipation, sputtering, isotopic flushing and thermal dissociation are reviewed. Neutron flux profiles and potential experimental configurations are presented and compared to other neutron source concepts. (auth)

00978 (UCID—16849) **DT fusion neutron irradiation of ANL electron microscopy samples.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jul 1975. Contract W-7405-Eng-48. 6p. Dep. NTIS $4.00.

The experimental parameters for irradiating the above specimens with 14-MeV neutrons from the LLL Rotating Target Neutron Source are described. No test results are given. (MOW)

00979 (UCID—16850) **DT fusion neutron irradiation of LASL YAG, spinel, and alumina samples, LLL supracil, LLL molybdenum and LLL photon interrupter.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jul 1975. Contract W-7405-Eng-48. 9p. Dep. NTIS $4.00.

The experimental parameters for irradiating the above specimens with 14-MeV neutrons from the LLL Rotating Target Neutron Source are described. No test results are given. (MOW)

00980 (UCID—16873) **DT fusion neutron irradiation of BPNL niobium.** MacLean, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jul 1975. Contract W-7405-Eng-48. 6p. Dep. NTIS $4.00.

The experimental parameters for irradiating the above specimen with 14-MeV neutrons from the LLL Rotating Target Neutron Source are described. No test results are given. (MOW)

00981 (UCRL—13639(Vol.1)) **Laser fusion study. Final report, volume I, study results.** (Hughes Aircraft Co., Culver City, Calif. (USA)). Jun 1975. 313p. Dep. NTIS $18.75.

For Univ. of California, Livermore.

The primary goal of this study was to devise, evaluate, and conceptually design a complete, end-to-end, alignment system capable of handling 30 to 32 Shiva amplifier chains to specified accuracies in space and time. A secondary goal was to accomplish the primary goal with an acceptably low development and procurement cost and with an acceptably high day-after-day performance reliability. This report presents such a system: it is comprised of sensors, actuating mechanisms, controls, and displays that perform well within the current art-state. (MOW)

00982 (UCRL—76856) **Livermore intense neutron source: design concepts.** Davis, J.C.; Anderson, J.D.; Booth, R.; Logan, C.M.; Osher, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1975. 39p. (CONF-750723—6). Dep. NTIS $5.00.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

The Lawrence Livermore laboratory proposes to build an irradiation facility containing several 14 MeV T(d,n) neutron sources for materials damage experimentation. A source strength of 4 x 10^{15} n/s can be produced with 400 keV D^+ beam on the tritium in titanium target system now used on the Livermore Rotating Target Neutron Source (RTNS). To produce the desired source strength an accelerator which can deliver 150 mA of 400 keV D^+ ions must be built. For the target to remain within the time-temperature regime of the present system it must have a diameter of 46 cm and rotate at 5000 rpm. With a beam spot 1 cm fwhm the useful target lifetime is expected to be the 100 hours typical of the present system. A maximum flux of 1.5 x 10^{15} n/cm^2 s will be attainable over a sample 1 mm thick by 8 mm in diameter. (auth)

00983 (UCRL—76857) **Characteristics of rotating target neutron source and its use in radiation effects studies.** Van Konynenburg, R.A.; Barschall, H.H.; Booth, R.; Wong, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1975. 17p. (CONF-750718—2). Dep. NTIS $4.00.

From International conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

The Rotating Target Neutron Source (RTNS) at Lawrence Livermore Laboratory is currently the most intense source of DT fusion neutrons available for the study of radiation effects in materials. This paper will present a brief description of the machine, outline the history of its development and discuss its performance characteristics and its application to CTR materials research. (auth)

00984 (UCRL—76881) **Mirror FERF.** Moir, R.W.; Taylor, C.E.; Doggett, J.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Aug 1975. 13p. (CONF-750725—12). Dep. NTIS $4.00.

From National solar photovoltaic program review meeting; Los Angeles, California, USA (22 Jul 1975).

This paper describes an up-dated version of the small mirror reactor for a Fusion Engineering Research Facility (FERF) and describes the present status of technology development and the goals required for the magnet, neutral beam injectors, plasma start-up, and remote handling operations. The conventional mirror FERF design has a "Yin-Yang" minimum parallel bar B parallel bar magnetic well with plasma end-losses sustained by continuous injection of up to 500 A of neutral particles. Injection energy is 65 keV (D^0) and 97.5 keV (T^0). A "low-field" version, 3.75 T central vacuum field, produces 3.4 MW of fusion power and about 10^{14} n/cm^2 . s uncollided 14-MeV neutron current emanating from the plasma. (auth)

00985 (UCRL—77021) **Test results of a 27 cm bore multifilamentary Nb_3Sn solenoid.** Zbasnik, J.P.; Nelson, R.L.; Cornish, D.N.; Taylor, C.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jul 1975. 14p. (CONF-750710—4). Dep. NTIS $4.00.

From International cryogenics materials conference; Ontario, Canada (Jul 1975).

A coil was constructed from a large, high current pre-reacted multifilamentary Nb_3Sn superconductor manufactured using the bronze method. The estimated bending strain during the winding was 0.6 percent. The coil performed to the short sample limit. This successful test demonstrates the potential feasibility of using multifilamentary Nb_3Sn, and perhaps other brittle A15-type superconductors in the construction of large, high field magnets. (auth)

00986 (ORNL-tr—2988) **First startup of the Siemens SL prototype magnets W VII in the IPP.** Amenda, W.; Kullmann, D.; Krueger, P.; Pillsticker, M. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany). Experimentelle Plasmaphysik 4). Aug 1974. Translation by R.G. Mansfield of IPP—4/120. 15p. Dep. NTIS $4.00.

The first test results with a big superconductive prototype coil developed for the Garching Stellarator W VII are reported. Flux jumping at low currents did not start quenching. The critical current of the Nb-Ti coil reaches 91 percent of the short sample value. The stored energy at quenching is 1.83 MJ and the maximum value of the magnetic field in the winding region is 61.5 kG. The mechanical stresses did not damage the windings. Degradation was not observed. A training of the coil was not necessary. Altogether the test was successful, as important technical problems were satisfactorily solved. Only parts of cryogenic systems should be improved in order to reduce the helium losses. (auth)

GENERAL AND MISCELLANEOUS

MANAGEMENT

00987 (ERDA—41) **WASH/ERDA report index. WASH and ERDA reports listed by number. Key-word-out-of-context (KWOC) index to report titles.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Administrative Services). Jul 1975. 187p. Dep. NTIS $7.60.

This index contains a listing of all unclassified AEC reports starting with WASH 1100 and unclassified ERDA reports through May 22, 1975 (ERDA 1—ERDA 42); it also includes a KWOC index to the approximately 1200 "key words" which appear in the WASH and ERDA report titles. The WASH series consists of administrative, scientific, and technical reports issued by the USAEC. This series closed when the AEC was abolished. The Energy R and D Administration then began an "ERDA" series. Certain WASH reports continue as ERDA reports. (RWR)

00988 (TID—26793) **1974 annual report to Congress. Part one: operating and developmental functions. Part two: regulatory functions.** (USAEC, Washington, D.C.). 1974. 253p. Dep. NTIS $7.60.

This report is of a nontechnical nature, with numerous photographs. The first part contains chapters on the reorganization of the AEC to ERDA and NRC, the history of the AEC: 1946—1975, energy research and development, breeder reactors, public health and safety, fusion research, environmental research, biomedical research, physical research, nuclear materials, national security, and management of radioactive waste. The part on regulatory functions contains chapters on nuclear regulation in 1974, 1974 nuclear power licensing, fuels and materials licensing, nuclear materials and plant protection, regulatory operations, nuclear standards development, public participation in regulation, and state and international liaison. Appendixes give membership of various boards and committees, changes in rules and regulations, a list of AEC regulatory guides, and a table of nuclear electric generating units in operation, under construction, or planned. (RWR)

00989 TO CONSIDER NATO MATTERS. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETY-THIRD CONGRESS, SECOND SESSION, FEBRUARY 19, 1974. Washington, DC; USA; Joint Committee on Atomic Energy (1975). 31p. GPO.

The hearings were carried out with General A. J. Goodpastor, U. S. Commander-In-Chief, Europe, U. S. European Command as principal witness. Subjects discussed were nuclear weapons capability and security in Europe, the NATO alliance, the proposed artillery-fired atomic projectile and atomic demolition munitions, and the possibility of war in Europe. (DLC)

00990 CURRENT MEMBERSHIP OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, JOINT COMMITTEE ON ATOMIC ENERGY MEMBERSHIP, PUBLICATIONS, AND OTHER PERTINENT INFORMATION THROUGH THE NINETY-THIRD CONGRESS, SECOND SESSION, JOINT COMMITTEE PRINT, NINETY-FOURTH CONGRESS, FIRST SESSION, APRIL 1975. Washington, DC; USA; Joint Committee on Atomic Energy (1975). 80p. GPO.

This pamphlet includes a list of unclassified publications issued by the Joint Committee, descriptions of atomic energy legislation enacted since 1946, a list of legislative reports, tabulation of committee reports on agreements for cooperation; locations of ERDA depository libraries in USA and abroad; tables tracing the membership of the committee and of AEC, ERDA, and NRC; a table of the length of member service on the committee and subcommittee; a statement of the committee organization and functions; and the most recent report to Congress. (DLC)

MATHEMATICS AND COMPUTERS

00991 (ANL—8153, pp 175-177) **Central real-time computer facility.** Day, P.P.; Hines, J.J.; Zielen, A.J. Jan 1975.

Chemistry Division annual report, July 1973—June 1974.

The computer facility of the ANL Chemistry Division is described. A central facility providing all real-time support, the system provides each on-line experimentalist with all the advantages of a moderate-sized computer while also providing the isolation enjoyed by individually dedicated minicomputer systems. The system contains 56K works of core, 75 Mbytes of disk storage, an on-line plotter, two nine-track tape drives, high-speed line printer, card reader, card punch, and paper tape reader—punch. The 24 on-line experiments using the system are tabulated. (1 table) (RWR)

00992 (BNL—20337) **Bragg reflection program.** Lynn, J.W. (Brookhaven National Lab., Upton, N.Y. (USA)). [nd]. 15p. Dep. NTIS $4.00.

This user's guide to the Bragg Reflection Program (BRP) is in the nature of an informal report. The general purpose of BRP is to scan a series of Bragg reflections automatically in order to obtain profiles and integrated intensities. The program is used in conjunction with the SUPERVISOR and READ packages, and the procedures for using it are similar to those for the Triple-Axis Control program. All the general features of the system, SUPERVISOR and READ packages as described in the Spectrometer Control Systems User's Guide are preserved. The presentation assumes that the reader is familiar with these. Sections are given on the READ package, execution and use, error messages, and output. A few sample problems are shown. (1 figure) (RWR)

00993 (CONF-741001—, pp 255-261) **NET-2 Network Analysis Program.** Malmberg, A.F. (Los Alamos Scientific Lab., NM). 1974.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Cube symposium, Lawrence Livermore Laboratory, October 23—25, 1974. Symposium proceedings.

The NET-2 Network Analysis Program is a general purpose digital computer program which solves the nonlinear time domain response and the linearized small signal frequency domain response of an arbitrary network of interconnected components. NET-2 is capable of handling a variety of components and has been applied to problems in several engineering fields, including electronic circuit design and analysis, missile flight simulation, control systems, heat flow, fluid flow, mechanical systems, structural dynamics, digital logic, communications network design, solid state device physics, fluidic systems, and nuclear vulnerability due to blast, thermal, gamma radiation, neutron damage, and EMP effects. Network components may be selected from a repertoire of built-in models or they may be constructed by the user through appropriate combinations of mathematical, empirical, and topological functions. Higher-level components may be defined by subnetworks composed of any combination of user-defined components and built-in models. The program provides a modeling capability to represent and intermix system components on many levels, e.g., from hole and electron spatial charge distributions in solid state devices through discrete and integrated electronic components to functional system blocks. NET-2 is capable of simultaneous computation in both the time and frequency domain, and has statistical and optimization capability. Network topology may be controlled as a function of the network solution. (auth)

00994 (HEDL-TME—75-45) **HDES5: a subroutine to solve a system of differential equations.** Gneiting, B.C.; Bard, F.E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2170. 28p. Dep. NTIS $4.00.

The subroutine HDES5 contains a numerical method for solving a system of first-order differential equations. Some features of the HDES5 subroutine are as follows: a fifth order predictor—corrector method is used; it performs very well in comparison with other differential equation system solver subroutines; it is easy to incorporate into large-scale computer programs; it has relatively low core storage requirements; the execution times are low for relatively smooth problems. (auth)

00995 (IS-T—675) **Iterative method for Fredholm equations of the first kind.** Peterson, W.C. (Ames Lab., Iowa (USA)). May 1975. Contract W-7405-eng-82. 115p. Dep. NTIS $8.75.

Thesis.

An iterative method is developed to find an approximation to the least squares solution of minimum norm, f_0, of an operator equation, $Kf = g$, of the first kind. In applications to integral equations, the superfluous oscillations in the final solution of methods in the literature are not an apparent problem. Letting K: H_1 yields H_2 be a completely continuous operator from a real separable Hilbert space H_1 to a real Hilbert space H_2, a sequence converging to f_0 is constructed, and stability and error bounds are obtained. (1 figure, 2 tables, 25 references) (auth)

00996 (UCRL—51794) **Determining the natural frequencies of spheroids via the boundary-value problem formulation.** Lytle, R.J.; Deadrick, F.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Apr 1975. Contract W-7405-Eng-48. 21p. Dep. NTIS $4.25.

Equations by which one can determine the natural frequencies of prolate and oblate spheroids are derived by using the boundary-value-problem approach. Both transverse magnetic and transverse electric excitations are considered. Numerical results are given for the natural frequencies of transverse-magnetic-excited prolate spheroids with various eccentricities, demonstrating natural mode dependence on eccentricity. Numerical difficulties, however, precluded obtaining natural frequencies for oblate spheroids, transverse-electric-excited prolate spheroids, and transverse-magnetic-excited prolate spheroids with sheaths. (9 figures, 4 tables) (auth)

00997 (UNI—339) **Slide layout and integrated design (SLIDE) program.** Roberts, S.G. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 19 Mar 1975. Contract AT(45-1)-1857. 27p. Dep. NTIS $4.50.

SLIDE is a FORTRAN IV program for producing 35 mm color slides on the Control Data CYBER-74. SLIDE interfaces with the graphics package, DISSPLA, on the CYBER-74. It was designed so that persons with no previous computer experience can easily and quickly generate their own textual 35 mm color slides for verbal presentations. SLIDE's features include seven different colors, five text sizes, ten tab positions, and two page sizes. As many slides as desired may be produced during any one run of the program. Each slide is designed to represent an $8^1/_2$ in. x 11 in. or an 11 in. x $8^1/_2$ in. page. The input data cards required to run the SLIDE program and the program output are described. Appendixes contain a sample program run showing input, output, and the resulting slides produced and a FORTRAN listing of the SLIDE program. (RWR)

INFORMATION HANDLING

00998 (TID—26500R1) **Subject categories used in Nuclear Science Abstracts, 1967—1975.** Whitson, M.O. (ed.). (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jul 1975. 23p. Dep. NTIS $4.00.

A history of the changes that have occurred in Nuclear Science Abstracts subject categories and their corresponding tag numbers since 1967 is presented in tabular format. (MCG)

00999 (TID—26770) **An analysis of world-wide contributions to Nuclear Science Abstracts, volumes 27 and 28(1973).** Cape, J.D. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Jun 1975. 77p. Dep. NTIS $5.45.

The literature appearing in Nuclear Science Abstracts (NSA) in 1973 is analyzed in 3 tables, 23 figures, and 2 appendixes. The analysis includes the total number of literature items contributed arranged by country of author affiliation and broken down into type of literature; the number of items in each NSA subject category contributed by each major contributing country of author affiliation; bar charts showing the growth of NSA and NSA categories over the years; the number and percent of items in each NSA category contributed by the major contributors; bar charts comparing major country contributions to NSA; and lists of journals with the number of items appearing in NSA arranged by country of journal publication and in order of decreasing number of items. (auth)

CORPORATE INDEX

In the corporate index, technical report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, where applicable, are given in parentheses at the end of the entry.

A

Aerojet Nuclear Co., Idaho Falls, Idaho (USA)
- Contempt-LT: a computer program for predicting containment pressure-temperature response to a loss-of-coolant accident, 01:00328 (ANCR—1219)
- Explosive hazards analysis of the eutectic solution NaK and KO_2, 01:00570 (ANCR—1217)
- Fish culture utilization of geothermal energy, 01:00181 (ANCR—1220)
- Heat transfer and friction correlations required to describe steam—water behavior in nuclear safety studies, 01:00334 (CONF-750804—3)
- Nuclear Technology Division annual progress report for period ending June 30, 1974, 01:00260 (ANCR—1177)
- Pipe blowdown analysis using explicit numerical schemes, 01:00335 (CONF-750804—4)
- Thermal fuels behavior program monthly report, CRO-119-75, 01:00354 (TID—26800)

Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.
- Geothermal space heating of a geothermal drilling rig, 01:00190 (ANCR—1241)
- Review and tentative selection of a working fluid for use with a medium temperature (300°F) geothermal resource, 01:00182 (ANCR—1224)

Aerospace Corp., El Segundo, Calif. (USA)
- Solar thermal conversion mission analysis. Volume III. Southern California insolation climatology, 01:00106 (PB—232670)
- Solar thermal conversion mission analysis. Volume IV. Mission/system and economic analysis, 01:00107 (PB—232671)
- Solar thermal conversion mission analysis. Volume II. Demand analysis, 01:00108 (PB—232679)

Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office
- Corrosion of high nickel alloys in combined fluoride solutions for nuclear fuel reprocessing, 01:00486 (ICP—1053)
- Evaluation of a continuous solid bowl centrifuge for processing simulated Rover dissolver effluent, 01:00034 (ICP—1073)
- Fluidized-bed calcination of simulated high-level commercial wastes. Interim report, 01:00053 (ICP—1075)
- Volatile ruthenium removal from calciner off-gas using solid sorbents, 01:00054 (ICP—1078)

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- On-line gamma—gamma angular correlation studies of cascades in ^{140}Ba, ^{90}Sr, and ^{140}Cs, 01:00830 (IS-T—673)
- PEAKFIND: a FORTRAN program for locating and fitting peaks in semiconductor detector spectra, 01:00644 (IS—3636)
- Phenomenological theory of the local magnetic field in Type-II superconductors, 01:00909 (IS-M—37)

Argonne National Lab., Idaho Falls, Idaho (USA)
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- Antiproton experiment facilities at Argonne, 01:00633 (ANL/HEP-CP—75-30)
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- Development of high-energy batteries for electric vehicles. Progress report for the period February 1969—June 1970, 01:00367 (APTD—1126)
- Dynamic response of two parallel circular cylinders in a liquid, 01:00223 (ANL-CT—75-40)
- Growth of salmonid fishes from heated and unheated areas of Lake Michigan: as measured by RNA-DNA ratios, 01:00670 (CONF-750425—7)
- Investigation of two-phase liquid-metal magnetohydrodynamic power systems, 01:00388 (CONF-750810—1)
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- Proceedings of the NEACRP meeting of a Monte Carlo study group, July 1—3, 1974, Argonne, Illinois, 01:00262 (ANL—75-2)
- Radiation transfer through specular passages. I. Diffuse incident radiation, 01:00151 (ANL-SOL—75-03)
- Reactor development program. Progress report, June 1975, 01:00224 (ANL-RDP—41)
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- Stable isotope ratiometer-multiple ion detector (SIRMID) unit for quantitative and qualitative stable isotope studies by gas chromatography-mass spectrometry, 01:00642 (CONF-750319—3)

Turning collectors: a compromise between stationary and heliostatic ones, 01:00153 (CONF-750712—5)
Atlantic Richfield Hanford Co., Richland, Wash. (USA)
Atlantic Richfield Hanford Company semiannual report, 02 process development, November 1, 1972—April 30, 1973, 01:00048 (ARH—2656B)
Compilation of Hanford corrosion studies, 01:00485 (ARH-ST—111)
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Corrosion of mild steel tank liners exposed to simulated solidified alkaline high-level waste, 01:00068 (BNWL—1869)
Decision model incorporating utility theory and measurement of social values applied to nuclear waste management, 01:00043 (BNWL-B—424)
Development of disposition criteria deviation methodology for commercial fuel cycle facilities, 01:00030 (BNWL-SA—5501)
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The subject index is based on the use of Descriptors selected from a controlled thesaurus of terms. Subject descriptors and qualifiers (subheadings) are selected and presented in the following format:

SUBJECT DESCRIPTOR;QUALIFIER
Title (supplementary information), citation number (report number)

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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CONF-7406105-	01:143	Washington, DC; National Science Foundation (1975).
CONF-740710-	01:262	See ANL-75-2
CONF-7409128-1	01:579	See BNL-20210
CONF-741017-37	01:878	See COO-2176-26
CONF-741079-17	01:939	See UCRL-75979
CONF-741164-1	01:773	See COO-2271-50
CONF-741210-	01:298	See STI/PUB-384
CONF-741215-3	01:703	See COO-3071-113
CONF-750130-1	01:734	See BNL-20155
CONF-750131-1	01:514	See COO-2390-8
CONF-750235-1	01:293	See HEDL-SA-757
CONF-750303-70	01:804	See COO-3126-29
71	01:862	See COO-2176-36
72	01:860	See COO-2176-35
73	01:827	See COO-2176-34
CONF-750307-8	01:744	See COO-1195-339
9	01:760	Dep. NTIS, $4.00
10	01:741	Dep. NTIS, $4.00
CONF-750319-3	01:642	Dep. NTIS, $4.25
CONF-750322-1	01:44	See Y-DA-6225
CONF-750335-26	01:630	See LBL-3364
66	01:628	See TRI-PP-75-1
71	01:632	See LBL-3376
72	01:627	See LBL-3693
CONF-750344-1	01:709	See UCRL-76755
CONF-750351-1	01:121	See COO-2577-8
CONF-750352-1	01:732	See COO-2456-11
CONF-750411-7	01:611	See DP-MS-74-58
8	01:331	Dep. NTIS, $4.25
9	01:310	See HEDL-SA-933
10	01:363	See ORNL-tr-4003
CONF-750418-3	01:332	Dep. NTIS, $4.50
CONF-750425-7	01:670	Dep. NTIS, $4.25
CONF-750426-2	01:692	See LBL-3388
CONF-750427-5	01:920	See UCRL-76491
6	01:877	Dep. NTIS, $4.00
CONF-750461-1	01:710	See LA-UR-75-791
CONF-750464-1	01:311	See HEDL-SA-934
CONF-750465-1	01:676	Dep. NTIS, $4.25
CONF-750468-1	01:333	Dep. NTIS, $6.25
CONF-750473-1	01:688	See COO-3380-17
CONF-750503-26	01:665	See BNWL-SA-5403
26	01:669	See UCRL-76570(Rev.2)
CONF-750518-3	01:966	See UCRL-76896
CONF-750520-10	01:940	See UCRL-76350
CONF-750531-7	01:935	See COO-2007-59
CONF-750546-2	01:900	See COO-323-33
CONF-750547-4	01:633	See ANL/HEP-CP-75-30
5	01:754	See COO-1195-343
6	01:737	See COO-1195-340
9	01:765	See COO-3130TA-321
CONF-750549-1	01:580	Dep. NTIS, $5.25
CONF-750551-1	01:640	See BNL-20100
CONF-750556-1	01:465	See LA-UR-75-934
CONF-750557-1	01:675	See BNL-20062
CONF-750602-1	01:205	See SAND-75-5295
CONF-750604-2	01:308	See HEDL-SA-915
3	01:309	See HEDL-SA-916
CONF-750606-4	01:934	See COO-2456-14
5	01:915	See COO-2456-15
6	01:932	See COO-2456-12
7	01:933	See COO-2456-13
CONF-750607-24	01:226	Dep. NTIS, $4.00
25	01:513	See ARH-SA-213
26	01:40	See BNWL-SA-5314
CONF-750608-9	01:80	See Y-DJ-17186
11	01:564	See LA-UR-75-1331
12	01:78	See SAND-75-0391
13	01:77	See SAND-75-0390
CONF-750615-1	01:206	See SAND-75-5531
CONF-750617-19	01:244	See WARD-5558
20	01:227	Dep. NTIS, $5.00
CONF-750631-4	01:749	See LA-UR-75-1284
5	01:748	See LA-UR-75-1244
6	01:783	See LA-UR-75-1265
7	01:785	See LA-UR-75-1274
8	01:771	See LA-UR-75-1281
9	01:761	See LBL-4207
10	01:871	See LBL-3887
11	01:885	See COO-3001-119
12	01:751	See LBL-3859
CONF-750636-2	01:789	See LA-UR-75-1278
CONF-750641-1	01:73	See LA-UR-75-876
2	01:14	See LA-UR-75-1127
CONF-750644-4	01:551	See BNWL-SA-5440
CONF-750646-1	01:561	Dep. NTIS, $6.75
CONF-750648-1	01:799	See BNL-20087
CONF-750649-1	01:743	Dep. NTIS, $5.75
CONF-750650-1	01:437	See LA-UR-75-1189
CONF-750652-1	01:555	See SAND-75-5309
CONF-750653-1	01:16	See UCRL-76923

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CONF-750654-		
1	01:739	See COO-3069-327
2	01:769	See COO-2232A-23
4	01:738	See COO-1195-341
5	01:790	See COO-1195-342
9	01:745	See COO-3065-119
CONF-750655-		
1	01:888	See LBL-4203
CONF-750657-		
2	01:414	See SAND-75-5610
CONF-750659-		
1	01:742	See ANL/HEP-CP-75-31
CONF-750660-		
1	01:614	See SAND-75-5237
CONF-750663-		
2	01:880	Dep. NTIS, $4.25
3	01:898	See LA-UR-75-1305
4	01:881	See COO-2171-47
CONF-750667-		
1	01:67	See ARH-SA-235
CONF-750669-		
1	01:389	See BNWL-SA-5503
CONF-750670-		
1	01:422	See Y-DA-6300
CONF-750671-		
1	01:664	See LBL-3646
CONF-750673-		
1	01:66	See ARH-SA-218
CONF-750703-		
11	01:648	See SAND-75-5607
13	01:558	See BNL-20253
CONF-750705-		
3	01:722	Dep. NTIS, $4.00
CONF-750706-		
8	01:656	See DP-MS-75-75
CONF-750707-		
2	01:695	See BNWL-SA-5170
4	01:696	See BNWL-SA-5296
5	01:637	See BNWL-SA-5299
CONF-750710-		
4	01:985	See UCRL-77021
CONF-750712-		
4	01:154	See LA-UR-75-1335
5	01:153	Dep. NTIS, $4.00
6	01:119	Dep. NTIS, $4.25
7	01:132	See UCRL-77208
CONF-750714-		
1	01:559	Dep. NTIS, $4.00
CONF-750715-		
1	01:210	See LA-UR-75-189
CONF-750716-		
2	01:458	See BNL-19798
6	01:607	See LA-UR-75-1099
7	01:972	See LA-UR-75-1032
10	01:418	See BNL-20292
CONF-750718-		
1	01:970	Dep. NTIS, $4.00
2	01:983	See UCRL-76857
CONF-750719-		
1	01:237	See HEDL-SA-982
2	01:346	See HEDL-SA-983
3	01:238	See HEDL-SA-984
4	01:236	See HEDL-SA-981
CONF-750722-		
1	01:18	See UCCND-CSD-INF-38
CONF-750723-		
1	01:88	Dep. NTIS, $4,00
2	01:976	See SAND-75-5442
3	01:960	See BNL-20241
4	01:961	See BNL-20263
5	01:973	See LA-UR-75-1232
6	01:982	See UCRL-76856
7	01:974	See LA-UR-75-1247
8	01:975	See LA-UR-75-1262
9	01:971	Dep. NTIS, $4.00
10	01:977	See SAND-75-5772
11	01:767	See LBL-3810
CONF-750725-		
1	01:103	See SAND-75-5717
12	01:984	See UCRL-76881
CONF-750801-		
3	01:926	See UCRL-76667
CONF-750804-		
1	01:339	See DP-MS-74-67
2	01:318	See DP-MS-74-66
3	01:334	Dep. NTIS, $8.50
4	01:335	Dep. NTIS, $5.50
5	01:336	Dep. NTIS, $5.00
6	01:304	Dep. NTIS, $4.00
8	01:618	See SAND-75-8610
9	01:337	Dep. NTIS, $5.00
CONF-750805-		
1	01:702	See LA-UR-75-1123
6	01:704	See LA-UR-75-1038
7	01:701	See LA-UR-75-1122
CONF-750806-		
2	01:5	See BNWL-SA-5457
CONF-750808-		
1	01:912	See UCRL-76562
CONF-750810-		
1	01:388	Dep. NTIS, $4.00
CONF-750811-		
1	01:464	See LA-UR-75-751
2	01:463	See LA-UR-75-750
CONF-750812-		
2	01:952	See LA-UR-75-736
3	01:228	Dep. NTIS, $4.25
8	01:394	Dep. NTIS, $4.00
11	01:613	See LA-UR-75-839
12	01:256	See BNL-20273
CONF-750816-		
1	01:469	See LBL-3755
CONF-750821-		
1	01:712	See UCRL-76299
CONF-750822-		
2	01:609	Dep. NTIS, $4.25
3	01:306	See DP-MS-75-61
6	01:31	Dep. NTIS, $4.00
CONF-750825-		
3	01:532	See LBL-3775
CONF-750827-		
2	01:909	See IS-M-37
CONF-750830-		
1	01:74	See SAND-74-5855
CONF-750902-		
8	01:52	See HEDL-SA-963
CONF-750905-		
1	01:929	Dep. NTIS, $4.00
2	01:944	See LA-UR-75-885
3	01:925	See LA-UR-75-864
4	01:941	Dep. NTIS, $4.00
5	01:914	Dep. NTIS, $4.00
6	01:928	Dep. NTIS, $4.00
7	01:964	See SAND-75-5537
8	01:942	Dep. NTIS, $4.00
9	01:943	Dep. NTIS, $4.00
16	01:921	See UCRL-77221
CONF-750906-		
1	01:216	See GA-A-13319
2	01:217	See GA-A-13383
CONF-750908-		
2	01:214	Dep. NTIS, $4.00
3	01:303	See ANL-CT-75-36
5	01:338	Dep. NTIS, $4.25
CONF-750911-		
1	01:229	Dep. NTIS, $5.25
3	01:213	See BNL-20307
4	01:221	See UNI-SA-13
6	01:218	See GA-A-13553
CONF-750913-		
1	01:599	Dep. NTIS, $4.00
2	01:89	See DP-MS-75-34
3	01:875	See UCRL-77103
4	01:590	Dep. NTIS, $4.00
6	01:592	See LA-UR-75-1364
7	01:593	See LA-UR-75-1402
9	01:32	Dep. NTIS, $4.25
CONF-750915-		
1	01:472	See UCRL-76537
2	01:591	Dep. NTIS, $4.00
3	01:467	See LA-UR-75-1347
4	01:468	See LA-UR-75-1354
5	01:466	See LA-UR-75-1258
6	01:533	See SAND-75-5081
8	01:861	See UCRL-76548
9	01:594	See MLM-2254(OP)
11	01:438	See LA-UR-75-1415
CONF-750916-		
1	01:230	Dep. NTIS, $5.00

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CONF-750917-1	01:694	See LA-UR-75-1324
CONF-750921-2	01:420	See LA-UR-75-804
CONF-750922-1	01:515	See GA-A-13432
CONF-750925-1	01:491	See SAND-75-5710
2	01:471	See SAND-75-5126
3	01:101	See DP-MS-75-16
5	01:490	See SAND-75-5159
CONF-750930-1	01:610	Dep. NTIS, $4.00
CONF-750946-1	01:180	See UCRL-77031
CONF-751001-1	01:686	Dep. NTIS, $4.00
CONF-751007-4	01:219	See LA-UR-75-1321
COO-		
323-33	01:900	Dep. NTIS, $4.00
323-34	01:641	Dep. NTIS, $4.00
1195-339	01:744	Dep. NTIS, $4.00
1195-340	01:737	Dep. NTIS, $4.00
1195-341	01:738	Dep. NTIS, $4.00
1195-342	01:790	Dep. NTIS, $4.00
1195-343	01:754	Dep. NTIS, $4.00
2002-24	01:671	Dep. NTIS, $4.25
2007-59	01:935	Dep. NTIS, $4.00
2059-47	01:930	Dep. NTIS, $5.75
2171-45	01:798	Dep. NTIS, $5.00
2171-47	01:881	Dep. NTIS, $4.00
2171-53	01:882	Dep. NTIS, $4.00
2176-26	01:878	Dep. NTIS, $4.00
2176-34	01:827	Dep. NTIS, $4.00
2176-35	01:860	Dep. NTIS, $4.00
2176-36	01:862	Dep. NTIS, $4.00
2195-12	01:708	Dep. NTIS, $11.75
2218-09	01:950	Dep. NTIS, $4.75
2232A-23	01:769	Dep. NTIS, $4.00
2245-20TR	01:231	Dep. NTIS, $5.45
2245-22TR	01:232	Dep. NTIS, $5.45
2271-50	01:773	Dep. NTIS, $4.25
2276-6	01:931	Dep. NTIS, $4.00
2283-5	01:681	Dep. NTIS, $4.00
2283-6	01:682	Dep. NTIS, $4.50
2362-7	01:679	Dep. NTIS, $5.00
2390-7	01:511	Dep. NTIS, $6.75
2390-8	01:514	Dep. NTIS, $4.25
2426-13	01:233	AT
2444-2	01:923	Dep. NTIS, $6.25
2444-2	01:924	Dep. NTIS, $6.25
2456—11	01:732	Dep. NTIS, $4.00
2456-12	01:932	Dep. NTIS, $4.00
2456-13	01:933	Dep. NTIS, $4.00
2456-14	01:934	Dep. NTIS, $4.00
2456-15	01:915	Dep. NTIS, $4.00
2479-5	01:864	Dep. NTIS, $4.00
2506-1	01:693	Dep. NTIS, $7.25
2509-3	01:778	Dep. NTIS, $4.00
2536-1	01:683	Dep. NTIS, $5.00
2577-4	01:120	Dep. NTIS, $14.50
2577-8	01:121	Dep. NTIS, $4.00
2606-T1	01:122	Dep. NTIS, $11.00
2606-T2	01:123	Dep. NTIS, $4.00
2606-T3	01:124	Dep. NTIS, $5.25
2606-T4	01:125	Dep. NTIS, $5.50
3001-118	01:786	Dep. NTIS, $5.50
3001-119	01:885	Dep. NTIS, $4.00
3028-18	01:951	Dep. NTIS, $4.00
3040-4	01:567	Dep. NTIS, $4.25
3058-63	01:779	Dep. NTIS, $4.75
3065-119	01:745	Dep. NTIS, $4.75
3069-327	01:739	Dep. NTIS, $5.50
3071-113	01:703	Dep. NTIS, $5.00
3075-63	01:774	Dep. NTIS, $4.50
3075-70	01:763	Dep. NTIS, $4.50
3085-42	01:687	Dep. NTIS, $4.00
3085-43	01:672	Dep. NTIS, $4.75
3126-29	01:804	Dep. NTIS, $4.00
3126-31	01:581	Dep. NTIS, $5.00
3130TA-321	01:765	Dep. NTIS, $4.00
3130TA-322	01:735	Dep. NTIS, $4.00
3130-TB-188	01:766	Dep. NTIS, $5.75
3130TB-214	01:746	Dep. NTIS, $6.00
3150-25	01:901	Dep. NTIS, $4.00
3221-33	01:582	Dep. NTIS, $4.25
3230-4	01:747	Dep. NTIS, $4.00
3234-25	01:674	Dep. NTIS, $5.50
3380-17	01:688	Dep. NTIS, $4.00
3380-22	01:689	Dep. NTIS, $4.00
3416-20	01:583	Dep. NTIS, $4.25
3429-26	01:460	Dep. NTIS, $6.00
3446-1	01:461	Dep. NTIS, $4.25
3476-11	01:431	Dep. NTIS, $8.50
3533-54	01:764	Dep. NTIS, $4.25
3566-11	01:668	Dep. NTIS, $8.25
DP-		
1367	01:305	Dep. NTIS, $4.00
1385	01:667	Dep. NTIS, $4.00
1388	01:50	Dep. NTIS, $4.00
1389	01:51	Dep. NTIS, $4.00
DP-MS-		
74-58	01:611	Dep. NTIS, $5.50
74-66	01:318	Dep. NTIS, $4.25
74-67	01:339	Dep. NTIS, $4.50
75-16	01:101	Dep. NTIS, $4.00
75-34	01:89	Dep. NTIS, $4.00
75-61	01:306	Dep. NTIS, $4.25
75-75	01:656	Dep. NTIS, $4.00
DPST-		
75-128-7	01:95	Dep. NTIS, $4.00
DUN-		
6664	01:319	Dep. NTIS, $4.00
7593	01:320	Dep. NTIS, $4.00
7630	01:321	Dep. NTIS, $4.00
7636	01:322	Dep. NTIS, $4.00
EGG-		
1183-2238	01:638	Dep. NTIS, $5.75
1183-2239	01:643	Dep. NTIS, $8.25
ERDA-		
7	01:76	Dep. NTIS, $5.45
41	01:987	Dep. NTIS, $7.60
59	01:366	Dep. NTIS, $5.45
1541(Vol.1)(Dr.)	01:340	Energy Research and Development Administration, Washington, DC
1541(Vol.2)(Dr.)	01:341	Energy Research and Development Administration, Washington, DC
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1541(Vol.4)(Dr.)	01:343	Energy Research and Development Administration, Washington, DC
1543(DR)	01:17	W.H. Pennington, Office of Asst. Admin., Wash., DC. Free
ERDA-tr-		
50	01:967	Dep. NTIS, $4.00
FIND-		
50524	01:252	Dep. NTIS, $4.00
50527	01:252	See FIND-50524
GA-A-		
13276	01:215	Dep. NTIS, $4.00
13298	01:234	Dep. NTIS, $4.00
13300	01:344	Dep. NTIS, $4.00
13319	01:216	Dep. NTIS, $4.00
13383	01:217	Dep. NTIS, $4.00
13423	01:235	Dep. NTIS, $4.00
13432	01:515	Dep. NTIS, $4.00
13553	01:218	Dep. NTIS, $5.25
GEAP-		
14014	01:279	Dep. NTIS, $5.45
20615	01:211	Dep. NTIS, $5.45
20936	01:345	Dep. NTIS, $4.00
GEPP-		
173	01:96	Dep. NTIS, $7.25
GERHTR-		
131	01:560	Dep. NTIS, $4.00
136	01:38	Dep. NTIS, $4.50
HASL-		
293	01:791	Dep. NTIS, $4.00
HEDL-SA-		
680	01:307	Dep. NTIS, $4.25
757	01:293	Dep. NTIS, $5.25
915	01:308	Dep. NTIS, $4.25
916	01:309	Dep. NTIS, $4.25
933	01:310	Dep. NTIS, $4.75

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934	01:311	Dep. NTIS, $5.25
963	01:52	Dep. NTIS, $4.75
981	01:236	Dep. NTIS, $5.25
982	01:237	Dep. NTIS, $4.25
983	01:346	Dep. NTIS, $5.75
984	01:238	Dep. NTIS, $4.00
HEDL-TME-		
73-34	01:436	Dep. NTIS, $4.75
74-30	01:239	Dep. NTIS, $5.45
74-47(Vol.2)	01:347	Dep. NTIS, $13.60
75-10	01:284	Dep. NTIS, $4.00
75-31	01:33	Dep. NTIS, $5.45
75-32	01:501	Dep. NTIS, $4.00
75-45	01:994	Dep. NTIS, $4.00
75-51	01:240	Dep. NTIS, $4.00
75-52	01:312	AT
75-75	01:241	Dep. NTIS, $4.00
75-79	01:313	Dep. NTIS, $5.75
ICP-		
1053	01:486	Dep. NTIS, $5.45
1073	01:34	Dep. NTIS, $4.00
1075	01:53	Dep. NTIS, $4.00
1078	01:54	Dep. NTIS, $5.45
IS-		
3636	01:644	Dep. NTIS, $7.75
IS-M-		
37	01:909	Dep. NTIS, $4.00
IS-T-		
673	01:830	Dep. NTIS, $10.50
675	01:995	Dep. NTIS, $8.75
KAPL-M-		
7412	01:462	Dep. NTIS, $5.50
KY-		
666	01:75	Dep. NTIS, $4.00
LA-		
5916	01:391	Dep. NTIS, $4.00
5931	01:324	Dep. NTIS, $5.45
5932	01:392	Dep. NTIS, $4.00
5952	01:780	Dep. NTIS, $4.00
5953-MS	01:365	Dep. NTIS, $4.00
5954	01:629	Dep. NTIS, $4.00
5963	01:314	Dep. NTIS, $4.00
5990-MS	01:781	Dep. NTIS, $5.45
5993-MS	01:55	Dep. NTIS, $4.00
5994-MS	01:719	Dep. NTIS, $4.00
6001-T	01:419	Dep. NTIS, $7.60
6011-MS	01:294	Dep. NTIS, $4.00
6017-MS	01:162	Dep. NTIS, $4.00
6022-MS	01:177	Dep. NTIS, $4.00
6032-MS	01:962	Dep. NTIS, $4.00
LA-DC-		
10923	01:72	Dep. NTIS, $5.25
LA-tr-		
75-14	01:247	Dep. NTIS, $7.75
LA-UR-		
75-189	01:210	Dep. NTIS, $4.00
75-736	01:952	Dep. NTIS, $4.00
75-750	01:463	Dep. NTIS, $4.00
75-751	01:464	Dep. NTIS, $4.00
75-791	01:710	Dep. NTIS, $4.50
75-804	01:420	Dep. NTIS, $4.00
75-839	01:613	Dep. NTIS, $4.00
75-864	01:925	Dep. NTIS, $4.00
75-872	01:663	Dep. NTIS, $4.00
75-876	01:73	Dep. NTIS, $4.00
75-885	01:944	Dep. NTIS, $4.00
75-934	01:465	Dep. NTIS, $4.25
75-956	01:315	Dep. NTIS, $4.00
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74-185	01:110	See PB-236159
MERC/SP-		
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2235	01:57	Dep. NTIS, $4.00
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74-25621	01:126	NTIS, $4.25
NASA-TM-X-		
70660	01:126	See N-74-25621
NE-		
3949-111-75	01:352	See ORO-4313-11
3949-112-75	01:352	See ORO-4313-11
NEACRP-L-		
118	01:262	See ANL-75-2
NP-		
20460	01:112	NSF/RANN
NRCI-		
75/3	01:253	TIC, $2.50
75/6	01:254	TIC, $4.00
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74-126	01:143	Washington, DC; National Science Foundation (1975).
74-187	01:399	Dep. NTIS (US Sales Only), $7.60
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37815/PR/74/1	01:109	See PB-235475
NSF/RANN/SE/GI-		
40457/PR/74/2	01:120	See COO-2577-4
41305/PR/74/2	01:110	See PB-236159
NVO-		
155(Vol.2)	01:654	Dep. NTIS, $19.75
269-23	01:666	Dep. NTIS, $4.00
ORNL-		
4988	01:257	Dep. NTIS, $7.60
4995	01:255	Dep. NTIS, $10.60
5044(Vol.2)	01:602	Dep. NTIS, $5.45
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4941	01:917	Dep. NTIS, $10.75
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4313-11	01:352	Univ. of Virginia, Charlottesville
4313-12	01:352	See ORO-4313-11
4449-6	01:752	Dep. NTIS, $4.00
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73622	01:739	See COO-3069-327
PATENTS-US-		
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3,890,197	01:296	
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197576	01:367	See APTD-1126
231115	01:105	NTIS, $6.75
232670	01:106	NTIS, $4.50
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232679	01:108	NTIS, $3.75
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238869(Vol.2)	01:111	NTIS, $37.50
RAR-		
652-340-002	01:325	Dep. NTIS, $4.00
696-13-001	01:326	Dep. NTIS, $4.00
RD/B/N-		
3421	01:444	Dep. NTIS (US Sales Only), $4.00
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3-16T(8-75)	01:415	RSO
3-18T(8-75)	01:416	RSO
6-6T(8-75)	01:512	RSO
RL-SEP-		
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1089-T1-P4	01:116	Dep. NTIS, $5.50
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75-0159	01:623	Dep. NTIS, $4.00
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Report No.	Abstract No.	Availibility
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74-0157	01:547	Dep. NTIS, $5.25
SLAC-Trans-		
169	01:635	Dep. NTIS, $4.25
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74-5209	01:155	NTIS
SM-		
200/18	01:219	See LA-UR-75-1321
204/1	01:73	See LA-UR-75-876
STI/PUB-		
384	01:298	IAEA, $39.00
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4206-54	01:764	See COO-3533-54
TI-		
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3319-S6	01:677	Dep. NTIS, $10.60
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24P223-2	01:357	See UCLA-34P203-2
34P172-16	01:552	Dep. NTIS, $4.00
34P203-1B	01:358	See UCLA-ENG-7472
34P203-2	01:357	Dep. NTIS, $6.00
34P224X1	01:163	Dep. NTIS, $4.50
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7472	01:358	Dep. NTIS, $10.50
7519	01:357	See UCLA-34P203-2
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34P107-170	01:736	Dep. NTIS, $4.25
34PA107-196	01:753	Dep. NTIS, $4.00
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13639(Vol.1)	01:981	Dep. NTIS, $18.75
13640(App.)	01:937	Dep. NTIS, $11.75
51718	01:359	Dep. NTIS, $4.00
51749	01:965	Dep. NTIS, $4.00
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0036T	01:703	See COO-3071-113
UR-		
534	01:881	See COO-2171-47
3055-14	01:673	Dep. NTIS, $10.50
3055-15	01:691	Dep. NTIS, $10.25
USGS-		
474-181	01:652	Dep. NTIS, $4.00
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1172	01:243	Dep. NTIS, $9.00
WARD-		
5558	01:244	Dep. NTIS, $4.75
WASH-		
1526 (Suppl.) DRAFT	01:653	USERDA, Washington, DC
WCAP-		
8456	01:212	Dep. NTIS, $5.00
X-		
704-74-139	01:126	See N-74-25621
Y-		
1972	01:606	Dep. NTIS, $4.00
1978	01:432	Dep. NTIS, $4.00
1984	01:433	Dep. NTIS, $4.00
Y-DA-		
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Y-DD-		
164	01:612	Dep. NTIS, $4.00
Y-DJ-		
17186	01:80	Dep. NTIS, $4.00

Abbreviations Used in Availability Column

AT Liquid Metal Fast Breeder Reactor applied technology is available to domestic requesters within the United States from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, TN 37830.
Information regarding subscription purchase will be sent on request.
Foreign requesters should address inquiries to the above address.

Dep. ERDA reports so designated are maintained in the organizations listed on the inside front cover.

EM Inquiries regarding the availability of blueline prints of ERDA engineering drawings which were formerly available for sale by NTIS should be addressed to USERDA, Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

GJO Available from USERDA, Grand Junction Office, P. O. Box 2567, Grand Junction, Colorado 81501.

GPO For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

LMEC Available *only to requesters within the United States* from the Liquid Metal Engineering Center, P. O. Box 1449, Canoga Park, CA 91304.

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RSO Available *only to requesters within the United States* from the Reactor Standards Office, Oak Ridge National Laboratory, P. O. Box X, Oak Ridge, TN 37830.

TIC Available from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.